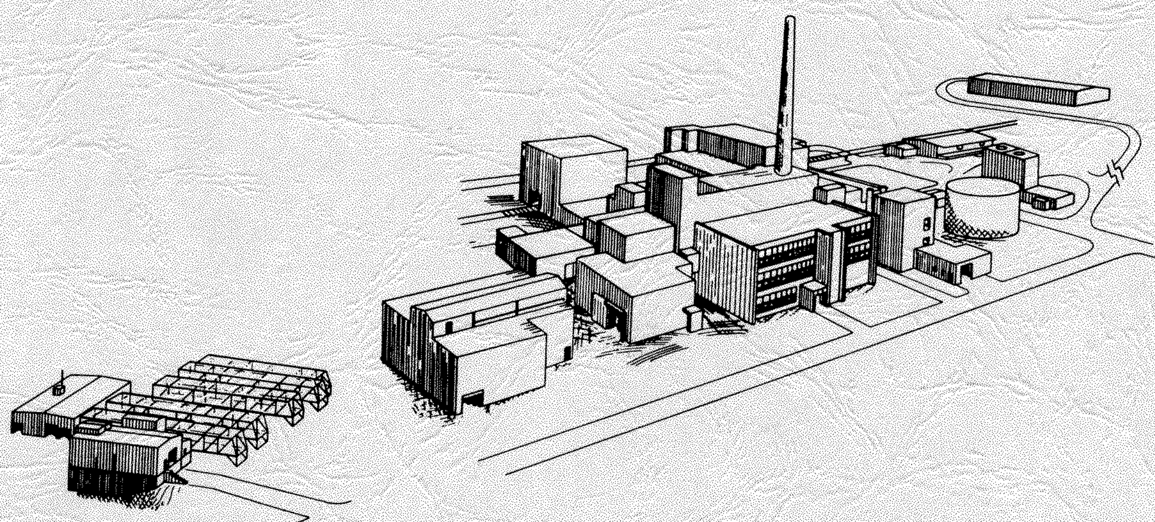
WEST VALLEY DEMONSTRATION PROJECT

SITE ENVIRONMENTAL REPORT

FOR CALENDAR YEAR 1989



May 1990

West Valley Nuclear Services Company, Inc.

Rock Springs Road

West Valley, New York 14171-0191

PREPARED FOR:
U.S. Department of Energy
Idaho Operations
West Valley Project Office
Under Contract DE-AC07-81NE44139

Department of Energy
Idaho Operations Office
West Valley Project Office
P.O. Box 191
West Valley, NY 14171

Greetings:

Enclosed is the U.S. Department of Energy (DOE) West Valley Demonstration Project (WVDP) Annual Site Environmental Monitoring Report for 1989. This report contains a summary of radiological and nonradiological environmental monitoring data collected at the WVDP during the 1989 calendar year.

The Project is successfully operating its Integrated Radwaste Treatment System, which stabilizes the high-level waste supernatant fluids, and it is continuing construction and testing of the vitrification facility in an environmentally acceptable manner.

In 1989 the Project focused on managing radioactive, hazardous, and radioactive mixed wastes in accordance with current and new regulations and the Project mission. Contamination of soil in the NDA from pre-WVDP organic solvent disposal was isolated by installing an interceptor trench to prevent movement off-site. Expansion of the groundwater monitoring program has now been completed, with more wells and comprehensive analyses available to characterize the site groundwater and subsurface soils. Other site characterization studies are being conducted to gather information to be used in preparing an Environmental Impact Statement for Project completion and eventual site closure.

Collection of air, water, soil, and food chain samples provides comprehensive detection and evaluation of any radioactive or hazardous material that may migrate off-site. The Project did not exceed or even approach any regulatory limit on radioactivity or radiation dose in 1989. Nonradiological plant effluents, which are controlled and permitted by the New York State Department of Environmental Conservation (NYSDEC) and the Environmental Protection Agency (EPA), were also generally below regulatory limits. Exceptions occurred in some treated waste water discharges permitted under the New York State Pollutant Discharge Elimination System (SPDES) program.

The WVDP is continuing negotiations with New York State and the Environmental Protection Agency concerning radioactive mixed waste management activities. These negotiations are aimed at achieving a Federal Facilities Compliance Agreement that will address permitting and compliance issues and a Consent Order that will address potential corrective action. These documents are expected to be signed in early 1991.

A more complete, up-to-date treatment of the issues involving Project commitment to operating the site in compliance with environmental requirements can be found in the Environmental Compliance Summary section.

This Report fulfills many DOE and regulatory reporting requirements and demonstrates that public health and safety are being protected with respect to the operation of the WVDP and the concerns associated with the waste materials being stored there. If you have any questions, please contact me at (716) 942-4313.

Sincerely,

Tom Rowland

T. J. Rowland, Acting Director
West Valley Project Office

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Preface

Environmental monitoring at the West Valley Demonstration Project (WVDP) is conducted by West Valley Nuclear Services Company, Inc. (WVNS), under contract to the U.S. Department of Energy. The data collected provide an historical record of radionuclide and radiation levels from natural and manmade sources in the survey area. Data also are collected to monitor the quality of air and water discharged by the Project, and wells adjacent to the site are routinely sampled.

This report represents a single, comprehensive source of off-site and on-site environmental monitoring data collected during 1989 by WVNS Environmental Laboratory personnel. Appendix A is a summary of the sampling and analysis plan. Appendices C through E contain summaries of all data obtained during 1989 and are intended for those interested in more detail than is provided in the main body of the report.

Requests for additional copies of the 1989 SITE ENVIRONMENTAL REPORT *and questions concerning the report should be referred to the WVDP Community Relations Department, P.O. Box 191, Rock Springs Road, West Valley, New York 14171 (716-942-4610).*

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Illustrations

Acronyms

ANOVA. Analysis of Variance

ALARA. As Low As Reasonably Achievable

BEIR. Committee on Biological Effects of Ionizing Radiation

CDDL. Construction and Demolition Debris Landfill (formerly the "cold dump")

CERCLA. Comprehensive Environmental Response, Compensation, and Liability Act

CSS. Cement Solidification System

DCG. Derived Concentration Guide

DE. Dose Equivalent

DOE. Department of Energy

DOE-HQ. Department of Energy, Headquarters Office

DOE-ID. Department of Energy, Idaho Operations

EA. Environmental Assessment

EE. Environmental Evaluation

EIS. Environmental Impact Statement

ELAP. Environmental Laboratory Accreditation Program

EML. Environmental Measurements Laboratory

EMSL. Environmental Monitoring Systems Laboratory (Las Vegas)

EPA. Environmental Protection Agency

FONSI. Finding of No Significant Impact

FY. Fiscal Year

HLW. High-level Radioactive Waste

ICRP. International Commission on Radiological Protection

INEL. Idaho National Engineering Laboratory

IRTS. Integrated Radwaste Treatment System

LLD. Lower Limit of Detection

LLW. Low-level Radioactive Waste

LLWTF. Low-level Liquid Waste Treatment Facility

LWTS. Liquid Waste Treatment System

MDC. Minimum Detectable Concentration

NCRP. National Council on Radiation Protection and Measurements

NDA. Nuclear Regulatory Commission Licensed Disposal Area

NEPA. National Environmental Policy Act

NESHAP. National Emission Standards for Hazardous Air Pollutants

NIST. National Institute of Standards and Technology

NFS. Nuclear Fuel Services Company, Inc.

NOI. Notice of Intent

NRC. Nuclear Regulatory Commission

NWPA. Nuclear Waste Policy Act

NYSDEC. New York State Department of Environmental Conservation

NYSDOH. New York State Department of Health

NYSERDA. New York State Energy Research and Development Authority

NYSGS. New York State Geological Survey

OSR. Operational Safety Requirement

QA. Quality Assurance

QAP. Quality Assurance Program

QC. Quality Control

RCRA. Resource Conservation and Recovery Act

RMW. Radioactive Mixed Waste

SAR. Safety Analysis Report

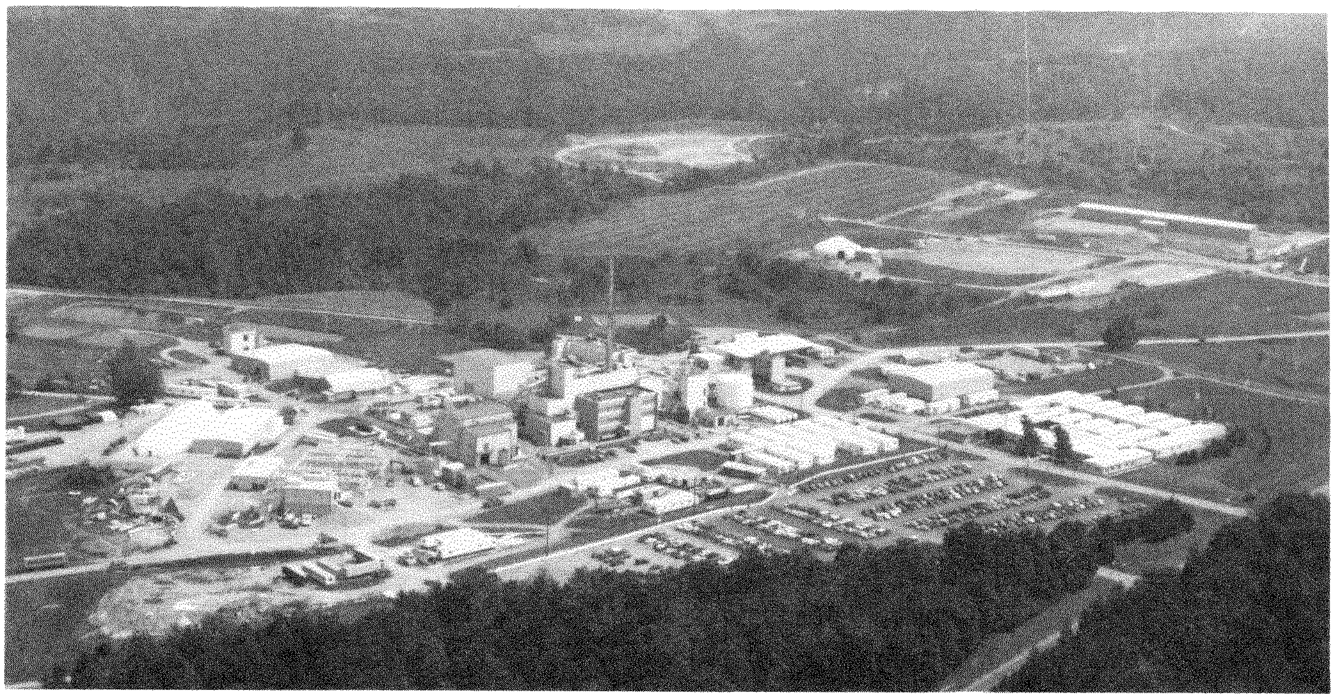
SI. International System of Units

SPDES. State Pollutant Discharge Elimination System

STS. Supernatant Treatment System

TLD. Thermoluminescent Dosimeter

USGS. U.S. Geological Survey



THE WEST VALLEY DEMONSTRATION PROJECT SITE

Executive Summary

The West Valley Demonstration Project (WVDP) conducts a comprehensive environmental monitoring program. This annual report presents a summary of the environmental monitoring data collected during 1989. The report is published in accordance with the requirements of United States Department of Energy (DOE) Orders 5484.1 and 5400.1. In addition to meeting DOE requirements, the site's environmental monitoring program fulfills regulatory requirements of the United States Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation (NYSDEC). In so doing, the program demonstrates that public health, safety, and the environment are being protected with respect to activities on the site and the waste materials stored there.

On-site and off-site radiological and nonradiological monitoring for 1989 confirm that site activities, with few exceptions, were conducted well within state and federal regulatory limits. The exceptions noted have resulted in no significant impacts upon public health or the environment and are described below.

History of the West Valley Demonstration Project

In the early 1950s, interest in promoting peaceful uses of atomic energy led to the passage of an amendment to the Atomic Energy Act under which the Atomic Energy Commission encouraged commercialization of nuclear fuel reprocessing as a way of developing a civilian nuclear industry. The Atomic Energy Commission made its technology available to private industry and invited proposals for the design, construction, and operation of reprocessing plants.

In 1961 the Office of Atomic Development acquired 3,345 acres near West Valley, New York and established the Western New York Nuclear Service Center (WNYNSC). The Davison Chemical Co., licensed by the New York Atomic Research and Development Authority, which later became the New York State Energy Research and Development Authority (NYSERDA), formed Nuclear Fuel Services, Inc. (NFS) to construct and operate a nuclear fuel reprocessing plant. NFS leased the Western New York Nuclear Service Center and began operations in 1966 to recycle fuel from both commercial and federally owned reactors.

In 1972, when the plant was closed for modifications and expansion, more rigorous federal and state safety regulations were imposed. Most of the changes were aimed at the disposal of high-level radioactive liquid waste and at preventing earthquake damage to the facilities. Compliance with these regulations was more costly than anticipated and, therefore, NFS decided in 1976 not to continue the plant modifications.

Following this decision the reprocessing plant was shut down. Under the original agreement between NFS and New York State, the state was ultimately responsible for both the radioactive wastes and the facility. Numerous studies followed the closing, leading eventually to the passage of Public Law 96-368 which authorized the Department of Energy to demonstrate a method for solidifying the 2.2 million liters (580,000 gals.) of liquid high-level waste that remained at the West Valley site. The technologies developed at West Valley would be used at other facilities throughout the United States. West Valley Nuclear Services Co. (WVNS), a subsidiary of Westinghouse Electric, was chosen by the Department of Energy to be operations contractor for the West Valley Demonstration Project.

The purpose of the West Valley Demonstration Project is to solidify the high-level radioactive waste left at the site from the original nuclear fuel reprocessing activities, develop suitable containers for holding and transporting the solidified waste, arrange transport of the solidified waste to a federal repository, dispose of any Project low-level and transuranic waste resulting from the solidification of high-level waste, and decontaminate and decommission the Project facilities.

Through the mid-1980s West Valley Nuclear Services, as prime contractor to DOE, secured environmental approval and constructed various subsystems that made possible the successful start-up of the Integrated Radwaste Treatment System (IRTS) in May 1988. In the first year of operation 523,000 liters (138,000 gals.) of liquid from the high-level waste tanks were processed through the IRTS. During the second year of operation, 1989, 931,000 liters (246,000 gals.) of liquid supernatant were processed.

Compliance

The West Valley Demonstration Project operates within the radiological guidelines of Department of Energy Orders for protection of health, safety, and the environment. Limits on radioactivity concentrations and individual doses are specified in the DOE Orders. The Project did not exceed or approach any of the limits on radioactivity or radiation doses in 1989, including the emission standards promulgated by the EPA and incorporated in DOE Orders.

Nonradiological plant effluents are permitted under New York State Department of Environmental Conservation (NYSDEC) and U.S. Environmental Protection Agency (EPA) regulations. New York State inspects nonradiological air emission points periodically even though air effluent monitoring is not currently required because of the nature of the discharges. Surface effluent water quality is tested for pH, biochemical oxygen demand, and other chemical factors and is regulated by the NYS Department of Environmental Conservation. The State Pollutant Discharge Elimination System (SPDES) permit identifies discharge water quality limits. In 1989 there were twenty-nine instances (5.5% of the measurements) when individual water quality parameters exceeded permitted levels, out of a total of 532 measurements. Six of these deviations resulted from natural variations in the iron content of raw water entering the plant. In each case, appropriate actions were taken to stabilize the condition and to notify NYSDEC in accordance with permit requirements. These deviations resulted in no significant impact on the environment.

Impacts upon site groundwaters are regulated by NYSDEC and the EPA. Groundwater sampling and analyses confirm that groundwater quality has been and continues to be affected both radiologically and nonradiologically by past facility operations. However, although definite radiological and nonradiological impacts upon groundwaters can be seen, these do not affect public health or the off-site environment.

Effluent And Environmental Monitoring

The 1989 environmental monitoring program provided radiological and nonradiological measurements of site effluent discharges and of other on-site and off-site samples. Collection of air and surface water samples provided monitoring of the two major pathways by which radioactive material could migrate off-site. Analysis of animal, soil, and vegetation samples from the facility environs provided data from which the risk of exposure to radioactivity through ingestion pathways could be determined. Control or background samples were taken to compare with on- or near-site samples. In 1989 the site recorded no abnormal radiological releases, and no special investigations of environmental radiological conditions were initiated.

Airborne particulate radioactivity was sampled continuously at five site perimeter and four remote locations during 1989. Sample filters were collected weekly and analyzed for gross alpha and beta radioactivity. Airborne gross activity around the site boundary was, in all cases, indistinguishable from background concentrations measured at the remote locations and was well below the Department of Energy limits. (See Appendix B). Direct monitoring of airborne effluents at the main plant stack and other permitted release points showed all discharges to be well below DOE or EPA effluent limitations. Nonradiological discharges from the site are regulated by NYSDEC; however, no special monitoring and reporting of nonradiological airborne effluents are required.

Four automatic samplers collected surface water at locations along site drainage channels. Samples were analyzed for gross alpha, gross beta and gamma activity, and for tritium and strontium-90. As a result both of past site activities and continuing treated liquid releases, average gross radioactivity concentrations continued to be higher in Buttermilk Creek below the West Valley Project site than at the upstream background sample point. Average concentrations below the Project site in Cattaraugus Creek are only marginally higher than background concentrations, i.e., upstream of the site, and only during periods of Lagoon 3 discharge. All Cattaraugus Creek concentrations observed are well below regulatory limits. Concentrations of cesium-137, strontium-90, and tritium were all below DOE guidelines at all locations, including Frank's Creek at the inner site security fence more than three miles from Cattaraugus Creek.

The low-level liquid waste treatment facility (LLWTF)contributes most of the activity released from the site in liquid discharges. In 1989 annual average concentrations of radionuclides were less than 30% of release guidelines. Downstream sediment concentrations of cesium-137 have remained constant at each sample point since the WVDP began making measurements, indicating that no accumulation is occurring as a result of Project activities.

Radioactivity that may pass through the food chain was measured by sampling milk, beef, hay, corn, tomatoes, beans, fish, and venison. The results were not very different from 1988 and corroborated the low calculated doses from site effluents.

Nonradiological liquid discharges are monitored as a requirement of the State Pollutant Discharge Elimination System (SPDES). Liquid discharge occurs at three permitted "outfalls" or points of final release to surface waters. Project effluents are monitored for biochemical oxygen demand (BOD), suspended solids, ammonia, iron, pH, oil and grease, and other water quality parameters. Monitoring indicated that nonradiological liquid discharges had no effect on the off-site environment.

Direct environmental radiation was measured quarterly in 1989, as in previous years, using thermoluminescent dosimeters (TLDs). Monitoring is carried out at forty-one points distributed around the site perimeter and access road, at the waste management units, at the inner facility fence, and at various background locations. No significant differences were noted among exposure rates measured at background stations and the WNYNSC perimeter locations. Some TLD data were also collected within the restricted area boundary to monitor the exposure from nearby radioactive waste handling and storage facilities.

Groundwater Monitoring

The WVDP is underlain directly by layers of glacial sand, clay and rock, and/or by layers of deposited lake and stream materials. Underlying bedrock is primarily Devonian shales and sandstones. As the material deposited across the site is not uniformly distributed, groundwater flow and seepage rates are uneven.

The 1989 groundwater monitoring program included on-site wells for surveillance of solid waste management units and off-site wells for drinking water monitoring. An on-site system of 14 wells, one groundwater seep, and a french drain (an underground, gravel-filled drainage channel) provided upgradient and downgradient monitoring of the low-level liquid waste treatment facility (LLWTF) lagoons, the high-level waste tank complex, the NRC-licensed disposal area, and other units. All wells comprising the on-site groundwater monitoring network were sampled eight times during 1989. After initial physical measurements at each well, samples were collected and analyzed for a variety of radiological and water quality parameters. The range of analyses performed was determined by regulatory requirements and site-specific concerns or needs. Statistical tests were performed to define real differences between up- and downgradient wells.

Data from groundwater monitoring around the LLWTF lagoons indicate that radionuclides from past plant operations have affected groundwater quality. Compared to background, both tritium and gross beta concentrations are elevated in groundwater surrounding the lagoon system. However, the level of tritium contamination has declined steadily since 1982, as indicated by measurements at the french drain outfall. Levels of gross beta activity appear to be rising slightly, as measured at the french drain outfall and at the well monitoring former Lagoon 1 (WNW86-05). Other measured parameters such as pH and conductivity have shown significant differences between upgradient and downgradient locations. Most notable are the sodium and chloride concentrations at the upgradient well (WNW86-06) within this unit. It is believed that these elevated salt concentrations are due to migration from the sludge ponds located just upgradient of well WNW86-06.

Data from monitoring wells around the high-level waste tanks do not suggest any impact of the stored high-level radioactive waste on the groundwater. However, significant differences between upgradient and downgradient wells do indicate that previous site activities have affected groundwater in this area. Most notable are elevated levels of gross beta activity and greater-than-detectable concentrations of 1,1-dichloroethane at wells WNW86-09 and WNW86-12.

Groundwater monitoring around the NRC-licensed disposal area (NDA) indicates no discernable impacts to the deeper deposits in the area, as indicated primarily by measurements for tritium. However, one shallow well in the vicinity of the NDA (WNW82-4A1) has consistently shown elevated tritium levels. In addition, continued organic solvent migration was detected in other shallow wells within the NDA. Migration of contaminated solvent is currently the focus of a control and remediation effort within the NDA.

The potential effect of Project activities on near-site groundwater is monitored by biennial sampling of groups of designated private drinking water wells as well as by the on-site measurements. Monitoring of drinking water wells off-site continues to demonstrate that the site has had no effect on residential drinking water supplies.

Radiological Dose Assessment

Potential radiation doses to the public from airborne and liquid effluent releases of radioactivity from the site during 1989 were estimated via computer models. Potential radiation doses from ingestion of locally produced foods were also calculated and compared to results derived from the computer models.

An EPA-approved computer program (AIRDOS, CAAC version) was used to calculate hypothetical radiation doses from airborne effluents. The highest whole-body dose to a nearby resident was estimated to be 0.0046 mrem, which is 0.018 % of the EPA limit. The highest dose to any organ was estimated to be 0.046 mrem (to the thyroid), which is 0.061% of the EPA limit.

Computer modeling was also used to estimate a hypothetical maximum radiation dose from liquid effluents. The highest dose to an individual was estimated to be 0.051 mrem, which is 0.051% of the DOE limit. Overall, the average dose from air and liquid discharges to individuals within an 80 km (50 mile) radius from the site was calculated to be 0.000038 mrem.

Radiation doses estimated from maximum consumption rates of locally produced foods ranged from 0.023 mrem (fish) to 0.092 mrem (milk). These doses are similar in magnitude to the values reported in previous years.

The above conservatively high, hypothetical calculated doses can be compared to an average dose of 360 mrem per year to a U.S. resident from natural background radiation. The dose assessment described in Section 4.0 predicts an insignificant impact on the public's health as a result of radiological releases from the WVDP.

Quality Assurance

The Quality Assurance (QA) program overseeing environmental monitoring activities includes the production of data from both on-site and off-site sources. Commercial contract laboratories and their own internal QA programs are routinely reviewed by site personnel. In addition, commercial laboratories must perform blind analyses of standard or duplicate samples submitted by the WVDP Environmental Laboratory.

On-site monitoring activities are subject to quality control checks from the time of sample collection through sample analysis and data reduction. Specific quality checks include: external review of sampling procedures, specific calibrations using primary standard materials, participation in formal laboratory crosscheck programs (for example, with EPA and DOE); and outside auditing by organizations including the U.S. Nuclear Regulatory Commission (NRC) and Westinghouse Electric Corporation.

Environmental sample sharing and co-location of measurement points with the New York State Department of Health (NYSDOH) and the NRC continued in 1989, ensuring that selected samples and locations are routinely measured by two or more independent organizations.

Crosscheck program participation coupled with other internal quality control procedures and external laboratory checks verified the overall high quality of data gathered in 1989. General program adequacy and specific issues of quality assurance were examined by a number of off-site agencies during 1989, including the DOE's first "Tiger Team." Isolated problems of quality control and/or program design that were identified have been or are currently being remedied. Overall, the program was found to be satisfactory.

THE NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
ASSISTS IN FISH SAMPLE COLLECTION

Program Summary

The environmental monitoring program for the West Valley Demonstration Project (WVDP), which began in February 1982, has been developed to detect any changes in the environment resulting from Project activities and to assess the impact of any such changes on the human population and the environment surrounding the site. Among the several factors considered in designing the environmental monitoring program were the kinds of wastes and other byproducts produced by the processing of high-level waste; possible routes that radiological and nonradiological contaminants could follow into the environment; geologic, hydrologic, and meteorological site conditions; quality assurance standards for monitoring and sampling procedures and analyses; and the limits and standards set by federal and state governments and agencies. The monitoring network and sample collection schedule have been designed to accommodate specific biological and physical characteristics of the area. As new processes and systems become part of the program, additional monitoring points are selected for sampling.

Monitoring and Sampling

The environmental monitoring program is comprised of effluent monitoring, off-site environmental surveillance, and on-site monitoring in which samples are measured for both radiological and nonradiological components. It includes both the continuous recording of data and the collecting of soil, sediment, water, air, and other samples at various times.

On-line effluent monitoring and sampling of environmental media provide two ways of assessing the results of on-site radioactive waste processing. Continuous effluent monitoring allows rapid evaluation of the environmental impact of site activities. Sampling is slower because it must be followed by laboratory analysis of the collected material, but it is capable of detecting much smaller quantities of radioactivity from proportional amounts of media being measured.

Data Summaries

Appendix A summarizes the 1989 environmental monitoring schedule at both on-site and off-site locations. Samples are designated by a coded abbreviation indicating sample type and location. (A complete listing of the codes is found in the index to Appendix A). Appendix A lists the kinds of samples taken, the frequency of collection, the parameters analyzed, and the location of the sample points.

Appendix B provides a partial list of the radiation protection standards set by the Department of Energy.

Appendix C summarizes analytical data from air, water, sediment, and biological samples (meat, milk, food crops, and fish) as well as the direct radiation measurements. For example, concentrations of various radionuclides in treated water, in streams and creeks, off-site well water, and air discharged from the main processing plant, the cement solidification system, and the supernatant treatment system are all provided in Appendix C.

Appendix D provides the data from the crosscheck analyses of samples by both the WVDP and independent laboratories. Radiological concentrations in crosscheck samples of air, water, soil, and vegetation are reported here as well as chemical concentrations from water crosscheck samples.

Appendix E summarizes the data collected from groundwater monitoring. Tables and graphs report concentrations at various locations of parameters such as gross alpha and beta, tritium or cesium, dissolved metals and fluoride.

Permits

Data gathering, analysis, and reporting to meet permit requirements are an integral part of the WVDP monitoring program. Selected media are sampled and analyzed to meet Department of Energy criteria and plant Operational Safety Requirements (OSR). The West Valley Demonstration Project participates in the State Pollutant Discharge Elimination System (SPDES) as required by the New York State Department of Environmental Conservation (NYSDEC). The site operates under state-issued air discharge permits for nonradiological plant effluents. Radiological air discharges must also comply with the National Emissions Standards for Hazardous Air Pollutants (NESHAP). (See the ENVIRONMENTAL COMPLIANCE SUMMARY and Appendix C-5 for more information and a list of permits).

Confidence Level

Because any two samples from the same homogeneous media (e.g., air, water) rarely will yield exactly the same measured value for a given parameter, the results of analyses can have only a limited degree of certainty, called *the confidence level*. For any chosen confidence level, e.g. 95%, upper and lower values can be calculated such that a measurement falling between those values will be a "true" value within the probability of the confidence level. The 95% confidence level used at the WVDP means that there is a 95% chance (19 out of 20) that the true value of the measured parameter is within the calculated range. (See Chapter 5 for a more detailed discussion of quality assurance statistics).

Exposure Pathways

The major pathways for potential movement of radionuclides away from the site are by surface water drainage and airborne transport. For this reason the environmental monitoring program emphasizes the collection of air and surface water. Samples are collected on-site at locations from which small amounts of radioactivity are normally released or might possibly be released. Such locations include plant ventilation stacks as well as various water effluent points and surface water seepage locations.

Air Pathways

Off-site sample collection locations include those areas considered most representative of background conditions and those areas most likely to be downwind of airborne releases. Among the criteria used to position off-site samplers are prevailing wind direction, groundwater and surface water drainage patterns, farm land usage, and population centers.

Air is continuously sampled at nine locations. Background samplers are located in Great Valley and Dunkirk, New York. Nearby community samplers are in Springville and West Valley, New York. Five samplers are located around the WNY Nuclear Service Center perimeter.

Effluent air emissions on-site are continuously monitored for alpha and beta activity with remote alarms to indicate any unusual rise in radioactivity. Air particulate filters which are retrieved and analyzed weekly for gross radioactivity are then composited quarterly and analyzed for strontium-90, isotopic gamma, and specific alpha-emitting nuclides.

Iodine-129 and tritium also are measured in effluent ventilation air. At two locations silica gel-filled columns are used to extract water vapor which is then distilled from the desiccant and analyzed for tritium content. Four samplers use activated charcoal adsorbent which is analyzed for radioiodine. The silica gel columns are retrieved weekly; the charcoal is collected monthly and composited quarterly.

Water and Sediment Pathways

Effluent water is collected regularly or, in the case of Lagoon 3, during release intervals, and analyzed for various parameters including gross alpha and gross beta, tritium, and pH. Additional analyses of composite samples determine metals content, biochemical oxygen demand, specific isotopic radioactivity, and conductivity.

On-site groundwater and surface water samples are collected regularly and analyzed, at a minimum, for gross alpha and beta, tritium, and pH. Selected samples are analyzed for conductivity, chlorides, phenols, heavy metals, biochemical oxygen demand, and other parameters. Potable water on the site is analyzed monthly for radioactivity and annually for hazardous constituents.

Off-site surface waters, primarily Cattaraugus Creek and Buttermilk Creek, are sampled both upstream of the Project for background radioactivity and downstream to measure possible Project contributions. Residential drinking water wells located near the site are sampled biennially and on-site water is analyzed for the same parameters. Sediments deposited downstream of the facility are collected semiannually and analyzed for gross alpha, gross beta, and specific radionuclides.

Food Pathways

A potentially significant pathway is the ingestion and assimilation of radionuclides by game animals and fish that include the WVDP in their range. Appropriate animal and fish samples are gathered and analyzed for radionuclide content in order to reveal any long-term trends. Fish are collected at several locations along Cattaraugus Creek and its tributaries at various distances downstream from the WVDP.

Human consumption of game animals, fish, domesticated farm animals, and produce raised near the WVDP presents another pathway that must be monitored. Meat, milk, hay, and produce are collected at nearby farms and at selected farms well away from any possible WVDP influence.

Atmospheric Fallout

An important contributor to environmental radioactivity is atmospheric fallout. Sources of fallout materials include earlier atmospheric testing of atomic explosives and, possibly, residual radioactivity from the Chernobyl nuclear power plant accident. Four site perimeter locations currently are sampled for fallout using pot-type samplers that are collected every month. Long-term fallout is determined by analyzing soil collected annually at each of the nine perimeter and off-site air samplers and from an additional site in Little Valley, New York, twenty-six kilometers from the WVDP.

Direct Radiation

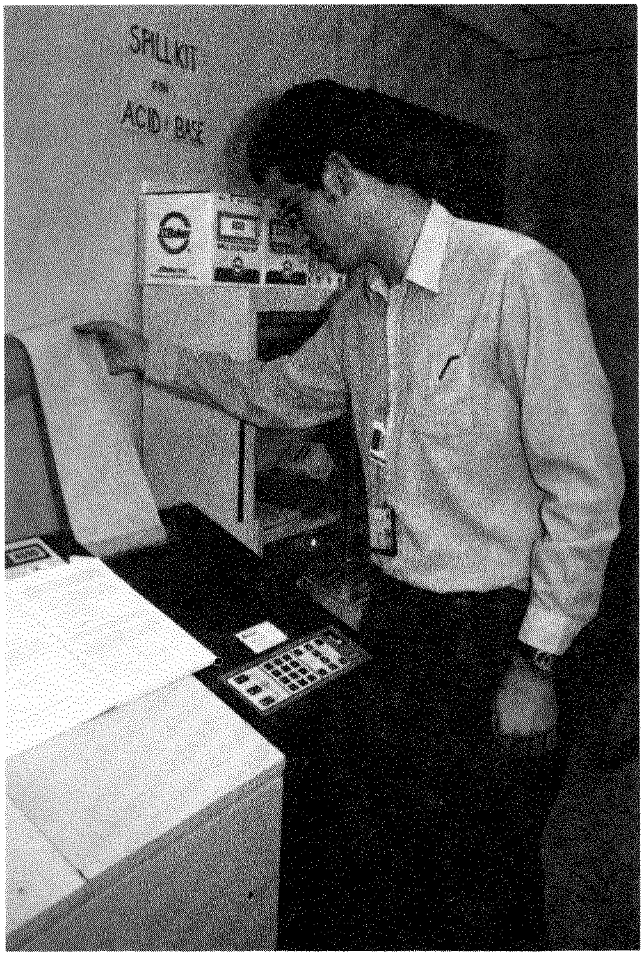
Direct penetrating radiation is continuously monitored using packets of TL-700 lithium fluoride (LiF) thermoluminescent dosimeters (TLDs) located on- and off-site. Monitoring points within the site are placed at waste management units and the inner facility fence. Other monitoring stations are situated around the site perimeter and access road and at background locations remote from the WVDP. (With the newest monitoring station in Sardinia activated at the beginning of the third quarter of 1989, forty-one monitoring points now exist). The measurement packets, five TLDs per packet, are retrieved quarterly and analyzed on-site to obtain the integrated gamma exposure.

Meteorological Data

Meteorological data are continuously gathered and evaluated on-site. Wind speed and direction, barometric changes, temperature, and rainfall are all measured. Such data are valuable when evaluating long-term trends and developing dispersion models. In the event of an emergency the data become an especially valuable tool for predicting the path and concentration of any material that becomes airborne.

Control of Quality

The work performed by the on-site environmental laboratory is regularly reviewed by several agencies for accuracy, compliance with applicable regulations, proper record keeping and reporting, timely calibration of equipment, training of personnel, adherence to accepted procedures, and general laboratory safety. Additionally, the environmental laboratory participates in several quality assurance programs administered by federal agencies. Outside laboratories contracted to perform analyses for the WVDP are regularly subjected to performance audits.



EXAMINING TRITIUM COUNTER DATA

ANALYZING SPDES WATER QUALITY SAMPLES

Environmental Compliance Summary

Background

The management of the WVDP is committed to operating the Project site in compliance with environmental requirements established by federal and state statutes and regulations, Executive Orders, U. S. Department of Energy Orders, and compliance agreements with federal and state regulatory agencies.

A summary of significant environmental activities at the WVDP with respect to regulatory compliance during 1989 and early 1990 is given below.

General Compliance Issues

Resource Conservation and Recovery Act (RCRA)

The WVDP has taken several steps to more effectively manage and document activities falling within the RCRA purview.

Hazardous Waste Generator Program

The WVDP fully implemented a formal hazardous waste generator program during 1989 and is maintaining compliance with all applicable New York State regulations. Four modular hazardous waste storage units complete with leak detection, alarm, and spill containment equipment were installed for interim storage of hazardous waste prior to off-site disposal by qualified waste disposal facilities.

A Hazardous Waste Generator Annual Report and a Waste Minimization Report filed with NYSDEC in February 1990 summarized 1989 hazardous waste management activities. In support of the national program to compile an inventory of each hazardous waste site the DOE owns or operates, an Inventory of Federal Hazardous Waste Activities was submitted to NYSDEC in January 1990 to meet RCRA section 3016 requirements.

Radioactive Mixed Waste Issues

Regulations addressing radioactive mixed waste (RMW) management activities became effective in New York State on May 7, 1990. The WVDP has been conducting negotiations with the state and the Environmental Protection Agency to resolve RMW compliance issues within the context of a Federal Facilities Compliance Agreement (FFCA) and consent order. The compliance deadline for interim status facilities is June 6, 1990. A RCRA Part A Treatment and Storage permit application will be submitted by the deadline. The Project's primary objective is to treat and stabilize the large quantity of high-level RMW presently stored in underground vaults. The WVDP has emphasized active coordination with regulatory agencies on the new RMW regulations to ensure that the WVDP mission will comply with applicable RCRA regulations.

Emergency Planning and Community Right-to-Know Act (EPCRA)

An on-going inventory of hazardous and toxic substances stored at the WVDP has been maintained since October 1987. An annual report (per 40 CFR Part 370) was submitted to the local fire departments, emergency response committees, and NYSDEC in March 1990 for the 1989 reporting period. This report lists substances exceeding certain threshold quantities, amounts stored on-site, and storage locations. A toxic chemical release report for 1989 will be submitted in July 1990 to the EPA and NYSDEC, pursuant to 40 CFR Part 372.

Clean Air Act (CAA)

Assessment of Air Emissions Sources

A comprehensive WVDP plot plan detailing the location of radioactive and nonradioactive air discharge vents and other emission points was completed in September 1989 and submitted to NYSDEC in January 1990.

The 1989 assessment of hypothetical dose commitments to the public from radioactive air emissions was calculated using the Clean Air Act computer model, as well as other models, for comparison. The 1989 summary of emissions and dose commitments to meet NESHAP requirements was reported to the EPA separately in the prescribed format.

Permit Preparation

Air permit applications for four permanent tanks that hold acids and caustic substances used in plant processes were submitted to NYSDEC in 1990. Applications are being prepared for portable tanks to be used for various vitrification feed chemicals. In addition, air permit applications were submitted for the maintenance shop welding and paint booth exhaust ventilation systems.

National Emission Standards for Hazardous Air Pollutants (NESHAP) Activities

The EPA NESHAP 40 CFR 61 revision promulgated in December 1989 provides a lower emissions standard beginning in 1990 and requires more detailed documentation of the sampling methods used to measure the releases. Evaluations of the WVDP emissions show that site airborne radioactivity releases are currently below limits incorporated in the new standards.

Clean Water Act

SPDES Issues

A number of excursions (measured effluent concentrations above the permitted levels) related to the sewage treatment plant operation occurred in 1989. The problems were almost all related to the high volume of use relative to the design capacity of the plant. Several corrective actions reduced the excursions. These included:

- Increasing the number of certified operators to eight in addition to one engineer.
- Removing solids from the equalization basin and issuing control procedures for basin operation.
- Installing a control valve to automatically shut off outfall flow if pH approaches permitted limits.
- Installing a boiler blowdown automatic pH adjustment system.
- Installing a filtration system to remove basin solids prior to discharge.

Evaluation of Sewage Treatment Plant

A review of the sewage treatment plant design and operation identified options for increasing its capacity to support the enlarged WVDP work force. A summary of the evaluation and planned actions was issued in January 1990.

The flow from the equalization basin SPDES outfall was discontinued during February 1990 and all collected fluids are being transported by licensed hauler to a permitted off-site sewage treatment plant to ensure that no excursions will occur while the appropriate modifications are being made to expand the plant capacity.

The WVDP SPDES permit (NY0000973) renewal application, which must be submitted every five years, was submitted May 16, 1990 and includes engineered modifications to increase the capacity from 10,000 to 25,000 gallons per day. Also completed were modification applications for treated effluent from the NDA solvent recovery trench and for metering of the effluent from the State Disposal Area Trench 14 treatment system into the LLWTF effluent outfall.

National Environmental Policy Act (NEPA) Activities

Phase II Environmental Impact Statement

On December 30, 1988 the Department of Energy issued a Notice of Intent to prepare an Environmental Impact Statement (EIS) for WVDP completion and closure of the Western New York Nuclear Service Center (WNYNSC). The EIS will consider alternatives for the disposition of all facilities and waste following completion of high-level waste vitrification.

To fulfill NEPA requirements, public scoping processes, including two public hearings on February 9, 1989, were conducted to identify issues and concerns related to the proposed actions.

Following completion of the scoping process in April 1989, a draft EIS Implementation Plan was prepared. The implementation plan provides a record of the scoping process, the proposed scope of the EIS, and the important issues to be evaluated.

Site characterization studies continued throughout 1989, although progress was slowed considerably during the second half of the year because of the Tiger Team audit and efforts to control solvent migration in the NDA (see Chapter 2, Section 2.6.2 below), which together required reorganizing priorities and resources.

Characterization studies in 1989 increasingly focused on a greatly expanded investigation of West Valley's multiple solid waste management units in order to meet both NEPA and RCRA requirements for the site. By year's end a draft groundwater sampling and analysis plan had been prepared and 35 new groundwater monitoring wells had been installed.

Phase I NEPA Activities

The Phase I NEPA program experienced considerable change in 1989. The June/July Tiger Team audit identified inconsistencies between DOE headquarters and DOE Idaho operations directives, resulting in revisions to internal WVNS NEPA policies and procedures, the requirement for new, expanded NEPA documentation for ongoing operations, and a revised DOE decision-making process.

Approximately 75 environmental checklists documenting proposed WVDP actions were processed during 1989. Seven of these actions required DOE preparation of memoranda-to-file and DOE headquarters' approval prior to beginning work.

In October 1989 the Project Office requested a comprehensive analysis of all WVDP Phase I activities to determine the validity and applicability of the original site EIS prepared in 1982. The analysis, which concluded that the 1982 EIS does not require formal supplementation, was completed in early 1990.

In February 1990 DOE Secretary Watkins issued a notice (SEN-15-90) which further redirected NEPA compliance at DOE facilties. The directive, which requires "full disclosure and complete assessment," will result in substantial revision of DOE Order 5440.1C, establishment of DOE NEPA procedures, and centralization of all DOE NEPA decision-making. The full implications of these orders will not be known until FY 91, when the NEPA directive is targeted for full implementation.

Control of Radiological Releases

Water Effluents

Four batch releases of treated water of about 2.5 million gallons (9.5 million liters) each occurred in 1989. These effluents were treated liquid from the low-level waste treatment facility which receives process waste water from Project activities. The discharged liquid had been tested at two previous points after treatment to ascertain its acceptability for release and was sampled during the discharge to confirm the previous measurements. The annual average concentration of radioactivity at the point of release was 25.2% of the DOE derived concentration guides (DCGs). None of the individual releases exceeded the DCG. The effect of the releases was marginally detectable in the water collected from Cattaraugus Creek at the nearest public access point. Several other points are monitored on-site, but other than the previously identified trace radioactivity levels from pre-Project site operations, no radioactivity releases were detected. No other surface water releases, planned or unplanned, occurred in 1989 from the WVDP.

Air Effluents

Six permitted radioactive air emissions points operated in 1989 with no incident of unplanned releases. Most of the released radioactivity was from the main plant ventilation exhaust stack, followed by the supernatant treatment system ventilation. A total of 35 billion cubic feet of air was filtered and exhausted in 1989 from these two facilities alone. The overall releases from the site ventilation units were less than 0.1 % of the limits specified by Operational Safety Requirements (OSR) and were, at the point of release, less than the DCGs which are applicable at the site boundary where the general public may be exposed. Calculations to demonstrate NESHAP compliance showed 1989 doses to be less than 0.01% of the revised standard of 10 mrem, which became effective in 1990.

Radiation Exposure of the Public

The total hypothetical dose commitments from site activities in 1989 were 0.056% of the 100 mrem (1 mSv) maximum to an individual member of the public, and an aggregate total to persons within a 50 mile (80 km) radius of 0.057 person-rem (0.00057 person-Sv). These calculated doses include air, water, and all other possible exposure pathways.

Current Issues and Actions

Radioactive Mixed Waste Subject to RCRA Regulation

On March 6, 1990, the EPA published a notice in the Federal Register (55 FR 7896) which authorized NYSDEC to regulate radioactive mixed waste under New York State hazardous waste laws and to implement regulations effective May 7, 1990. In order to obtain interim status for radioactive mixed waste facilities the WVDP must submit a RCRA Part A permit application by June 6, 1990 to NYSDEC and the EPA. Relative to the above regulatory changes, the Project is negotiating a Federal Facilities Agreement with the EPA and NYSDEC, as noted above.

Site Characterization

A major effort is now under way to characterize the site to provide field measurements for the site closure EIS and for compliance with RCRA regulations. Soil characterization from borings, surface investigation, and historical data has been one focal point of activity. A companion investigation of the hydrology and water quality of the solid waste management units (SWMUs) has been the other major activity. A number of other disciplines are scheduled for investigation and documentation relative to the characterization activities. Upon completion of the characterization, each area will be described in an Environmental Information Document (EID) that will serve as a reference for EIS preparation.

Waste management

Vitrification Progress

In 1989 the successful completion of cold testing set the stage for the final construction phase of the vitrification facility. The slurry-fed ceramic melter was removed from the cold test stand and construction of the facility shield walls, transfer tunnel, and air handling structures began. The tanks and building to house the nonradioactive additives to the vitrification feed slurry are being installed to the west of the facility. Construction activity on these projects is expected to continue during 1990.

Cement Solidification

The cement solidification system (CSS) continued to operate in 1989 and 1990, encapsulating the liquid salt concentrate from the HLW supernatant treatment system in special square drums. The drums are being stored in the drum cell, which housed more than 8,000 containers as of May 1990. The CSS product has been evaluated and endorsed by the NRC as meeting the criteria for class C low-level radioactive waste disposal under 10 CFR 61. Testing has demonstrated that the product is classified as nonhazardous according to current EPA/NYSDEC hazardous waste classification criteria.

Overall Low-level Waste Management

The Project continued to effectively manage low-level radioactive waste in 1989 and 1990. The volume of waste to be stored was reduced by cutting bulky tanks and piping formerly used in the reprocessing plant into smaller pieces. This process, carried out inside a stainless steel-lined room with special ventilation, results in more easily handled and stored packaged waste.

An implementation plan for managing radioactive mixed waste was completed and issued in October 1989. The plan details the operational requisites and administrative reporting required by the regulations.

The byproduct solid wastes from the low-level waste treatment facility were characterized and bench-scale tested to obtain the best recipe mixtures for solidification. Full scale solidification demonstrations were performed on various batches of byproduct sludge to ensure that the resulting waste forms comply with DOE and NRC disposal criteria.

Chemical and Petroleum Bulk Storage Tank Program

A review of chemical and petroleum bulk storage tanks which are registered in accordance with NYSDEC requirements was completed in March 1990. The phase-in of the petroleum bulk storage requirements has been initiated as required by New York State.

Improvements in accountability for petroleum spills were made by initiating the monthly Petroleum Spill Report, which maintains a log of all minor spills to be reported to NYSDEC.

NDA Interceptor Trench

The area around the buried solvent tanks in the NDA was investigated in 1989 as a continuation of the 1988 studies. A report issued in December 1989 recommended that solvent recovery should be enhanced by intercepting the contaminant migration at the plume front.

A continuous trench 880 feet long was planned, with the first 200 feet installed in spring of 1990. Recovery and treatment methods are being tested on this section before completing the trench. An application for a modification to the site's existing SPDES permit is being sought to allow transfer of the treated water to the Project LLWTF.

Permitting Activities

- The Permit to Construct for the vitrification facility off-gas treatment system for nonradioactive testing operations was terminated after the completion of the initial "cold testing" in 1989. An application for a permit to construct the permanent off-gas treatment system is now in preparation.

- Applications for permits to modify the plant boilers in order to burn #6 fuel oil and to operate a blueprint shop exhaust and a chemistry lab hood exhaust are currently being prepared for submittal to the NYSDEC.

- The current SPDES permit expires in September 1990; the permit renewal application was submitted to NYSDEC in May 1990. The renewal request included several modifications to reflect sewage treatment plant upgrades and operational process stream changes. A modification to allow treatment of the water from the NDA solvent recovery operation was submitted in March 1990. A modification to permit the metering of treated state disposal area (SDA) effluent during LLWTF discharges is included in the 1990 renewal application.

- A RCRA Part A permit application for the treatment and storage of radioactive mixed waste will be submitted to NYSDEC in 1990.

Asbestos

The Asbestos Management Plan was issued in draft form in May 1990. Abatement work in areas designated in the Management Plan as requiring high priority is scheduled for later in 1990.

Employee training and awareness programs have been initiated, including EPA/NYS Department of Labor certified training for several WVDP asbestos workers and inspector/management planners.

Tiger Team Evaluation

From July 7 to July 28, 1989 a team of twenty-four managers and consultants selected by the Secretary of Energy investigated all areas of Project operations related to environmental surveillance, monitoring, and compliance with environmental regulations. A previously scheduled Technical Safety Appraisal was combined with the Tiger Team assessment. The team issued a combined report of their findings in August 1989, which formed the basis for follow-up actions by the Project.

The Assessment team did not identify any problems at the WVDP that present an undue risk to public or worker health or the environment. Emissions, worker exposure, and the occupational safety record compared favorably to the average for DOE facilities and the industry as a whole.

The Tiger Team Assessment report is available at the WVDP for public review.

U.S. Department of Justice Investigation

On September 21, 1990, officials of the West Valley Demonstration Project were informed that no criminal charges were warranted as a result of the U.S. Department of Justice's extensive investigation that began in July 1989.

1.0 Introduction

The West Valley Site

Location

The West Valley Demonstration Project is located in a rural area approximately 50 km (30 mi) south of Buffalo, New York (Figure 1-1), at an average elevation of 400 m (1,300 ft) on New York State's western plateau. The plant facilities used by the Project occupy approximately 63 hectares (156 acres) of chain-link fenced area within a 1,350-hectare (3,300-acre) reservation that constitutes the Western New York Nuclear Service Center (WNYNSC). The communities of West Valley, Riceville, Ashford Hollow, and the village of Springville are located within 8 km (5 mi) of the plant. Several roads and one railway pass through the Center, but no human habitation, hunting, fishing, or public access are permitted on the WNYNSC.

Economic Activities

The land immediately adjacent to the WNYNSC is used primarily for agriculture and arboriculture. Cattaraugus Creek serves as a water recreation area (swimming, canoeing, and fishing). Although limited irrigation water for adjacent golf course greens and tree farms is taken from Cattaraugus Creek, no public water supply is drawn from the creek downstream of the WNYNSC.

Climate

Although there are recorded extremes of 37 ^{o}C (98.6 ^{o}F) and -42 ^{o}C (-43.6 ^{o}F) in the region, the Western New York climate is moderate, with an average annual temperature of 7.2 ^{o}C (45.0 ^{o}F). Rainfall is relatively high, averaging about 104 cm (41 in.) per year. Precipitation is evenly distributed throughout the year and is markedly influenced by Lake Erie to the west and Lake Ontario to the north. All surface drainage from the WNYNSC is to Buttermilk Creek, which flows into Cattaraugus Creek and ultimately into Lake Erie. Regional winds are predominantly from the west and south at about 4 m/s (9 mph) during most of the year.

Vegetation and Wildlife

The WNY Nuclear Service Center lies within the northeastern deciduous forest biome, and the diversity of its vegetation is typical of the region. Equally divided between forest and open land, the site provides habitats especially attractive to white-tailed deer and various indigenous birds, reptiles, and small mammals. No endangered species are known to be present on the WNYNSC.

Geology

The site is characterized by glacial deposits of varying thickness in the valley areas, underlain by sedimentary rocks which are exposed in the upper drainage channels in the hillsides. The soil is principally silty till consisting of unconsolidated rock fragments, pebbles, sand, and clays. The uppermost till unit is the Lavery, a very compact, gray, silty clay. Below the Lavery till is a more granular area referred to as the lacustrine unit, which is made up of silts, sands, and, in some places, gravels that overlie a layered clay.

There are two aquifers in the site area but neither are considered highly permeable. The upper aquifer is a transient water table in the upper 6 m (20 ft) of weathered till and alluvial gravels concentrated near the western edge of the site. High ground to the west and the Buttermilk Creek drainage to the east intersect this aquifer, precluding off-site continuity. Several shallow, isolated, water-bearing strata also occur at various other locations within the site boundary but do not appear to be continuous.

The zone at which the till meets bedrock forms another aquifer consisting of decomposed shale and rubble that ranges in depth from 2 m (6 ft) underground on the hillsides to 170 m (560 ft) deep just east of the Project's exclusion area. The groundwater flow patterns are related to the recharge and downgradient movement for the two aquifers. Groundwater in the surficial unit tends to move east or northeast, close to Rock Springs Road. Most of this groundwater empties into Frank's Creek. Groundwater from the second aquifer tends

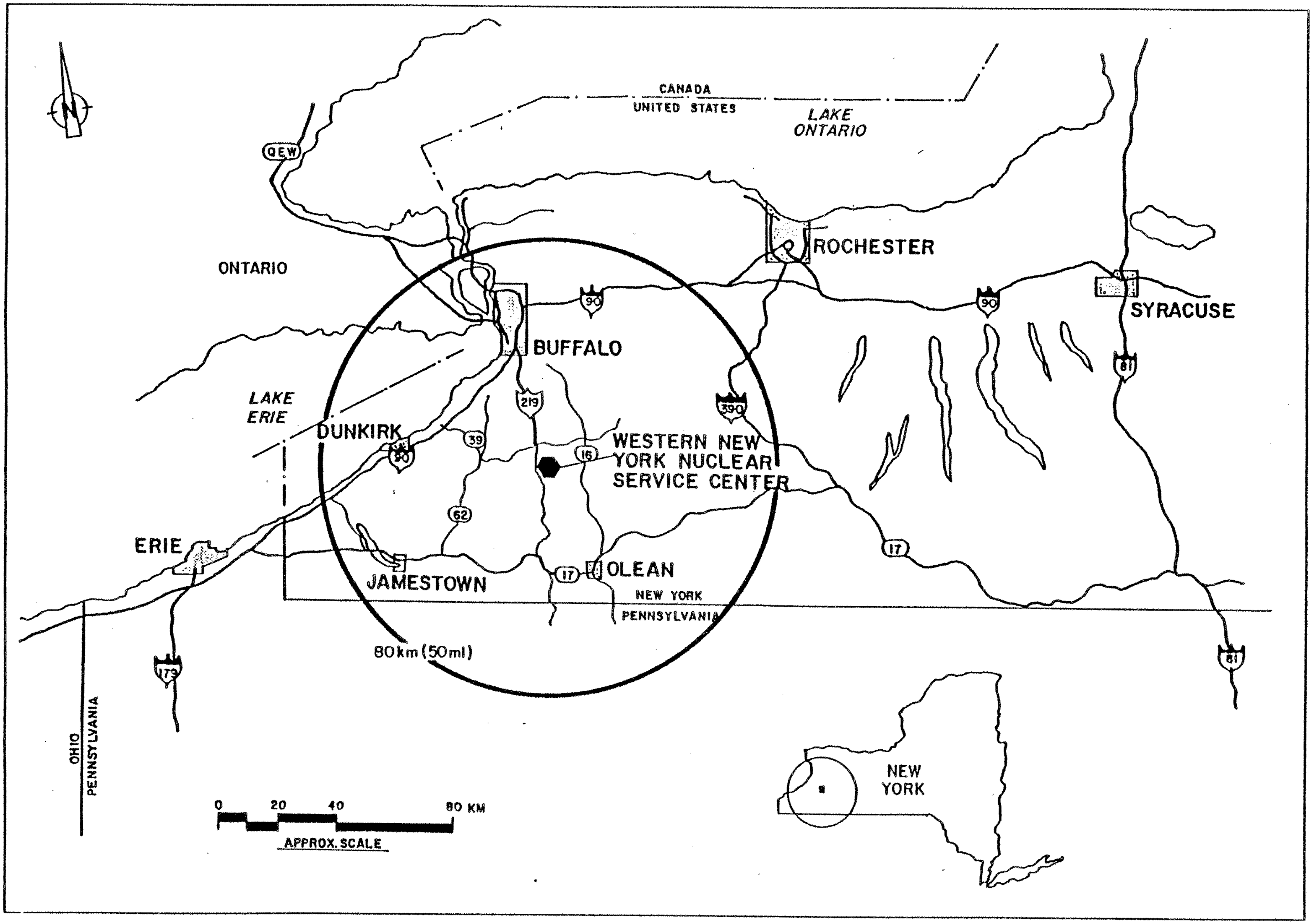


Figure 1-1. Location of the Western New York Nuclear Service Center

to move east toward the lowest point of the site, about 300-350 meters west of Buttermilk Creek, and turns to flow north-northwest.

Radiation and Radioactivity

As the Western New York Nuclear Service Center is no longer an active nuclear fuel reprocessing facility, the major interest of the environmental monitoring program is with the radiation and radioactivity levels associated with the cleanup activities. The following information about radiation and radioactivity may be useful in understanding the activities of the Project and the terms used in reporting the results of environmental testing measurements.

Radioactivity is a property of unstable atomic nuclei that spontaneously disintegrate or change into atomic nuclei of another isotope (see Glossary) or element. As they decay the total radioactivity is reduced until only a stable nonradioactive isotope remains. This process can take anywhere from less than a second to hundreds of thousands of years.

Radiation is a general term used to describe several forms of energy, including the energy that accompanies decay of atomic nuclei. Radiations from radioactive materials that are of primary interest take three forms: alpha or beta particles, and gamma rays.

- Alpha Particles

An alpha particle may be emitted as a fragment from a much larger nucleus. It consists of two protons and two neutrons, just like a helium nucleus, and is positively charged. Alpha particles are relatively large and heavy and do not travel very far when ejected by a decaying nucleus. Alpha radiation thus is easily stopped by a thin layer of material such as paper or skin. However, if radioactive material is ingested or inhaled, the alpha particles released inside the body can damage soft internal tissues.

- Beta Particles

A beta particle is an electron that results from the breakdown of a neutron in a radioactive nucleus. Beta particles are small compared to alpha particles, travel at a higher speed (close to the speed of light), and can be stopped by a material such as wood or aluminum an inch or so thick. If beta particles are released inside the body they do much less damage than alpha particles (assuming that equal amounts of energy are absorbed by the tissue).

- Gamma Rays

Gamma rays are high-energy "packets" of electromagnetic radiation called photons. They are similar to x-rays but have a shorter wavelength and therefore are more energetic than x-rays. If the alpha or beta particle released by the decaying nucleus does not carry off all the energy available, the nucleus rids itself of the excess energy by emitting gamma rays. The released energy produces a very penetrating gamma ray which can only be effectively reduced by several inches of a heavy element such as lead. Although large amounts of gamma radiation are dangerous, gamma rays are also used in many lifesaving medical procedures.

Ionizing Radiation

Radiation can be damaging if, in colliding with other material, the alpha or beta particles or gamma rays knock loose electrons from the absorber atoms. This process is called ionization, and the radiation that produces it is referred to as ionizing radiation because it changes a previously neutral atom into a charged atom called an ion. (See Glossary).

Various kinds of ionizing radiation produce different degrees of damage. The **relative biological effectiveness** (RBE) or **quality factor** (QF) of a particular kind of radiation indicates the extent of cell damage it can cause compared with equal amounts of other ionizing radiations. Alpha particles cause twenty times as much damage to internal tissues as x-rays, and so alpha radiation has a QF of 20 compared to gamma rays, x-rays, or beta particles.

Background Radiation

Background radiation is always present and everyone is constantly exposed to low levels of such radiation from both naturally occurring and man-made sources. The average total annual exposure to this low-level background radiation is estimated to be about 360 millirem (mrem). Most of this radiation, approximately 300 mrem, comes from natural sources. The rest comes from medical procedures and from consumer products.

Background radiation includes cosmic rays, the decay of natural elements such as potassium, uranium, thorium, and radon, and radiation from sources such as chemical fertilizers, smoke detectors, and televisions. Actual doses vary depending on such factors as geographic location, building ventilation, and personal health and habits.

Units of Measurement

Radiation is described in three ways: The rate of emission, the amount of energy absorbed, or the biological effect.

Nuclear disintegrations.

The rate at which radiation is emitted can be described by the number of nuclear transformations that occur as an isotope decays and changes into another isotope. This process, or radioactivity, is measured in curies or becquerels. One becquerel equals one decay per second. One curie equals 37 billion nuclear disintegrations per second (3.7×10^{10}d/s). Very small amounts of radioactivity are sometimes measured in picocuries. A picocurie is one-trillionth (10^{-12}) of a curie.

Energy absorbed:

Radiation effects can be predicted based on the amount of energy absorbed by the receiving material, measured in rads (radiation absorbed dose) or grays. A rad is defined as a dose of 100 ergs of radiation energy absorbed per gram of material while a gray is one joule per kilogram. Energy can also be expressed in terms of electron volts (eV). However, as an electron volt is such a small amount of energy one usually refers to a million electron volts or MeV. Thus, a gamma ray photon from barium-137m (from cesium-137) would have an energy of 662,000 eV or 0.662 MeV. (One rad equals 62.5×10^6 MeV of energy per gram of material).

Biological effect:

A third measure of radiation is the rem, the unit of "dose equivalent" which is proportional to the biological damage to tissue produced by different kinds of ionizing radiation. Rems are equal to the number of rads multiplied by a "quality factor" which is related to the relative biological effectiveness of the radiation involved. Dose equivalents can also be measured in sieverts. One sievert equals 100 rem. (See Chapter 4, " Radiological Dose Assessment" for more information).

Potential Effects of Radiation

The biological effects of radiation can be either somatic or genetic. *Somatic* effects are restricted to the person exposed to radiation. For example, sufficiently high exposure to radiation can cause clouding of the lens of the eye, or loss of white blood cells.

Radiation also can cause chromosomes to break or rearrange themselves or to join incorrectly with others. These changes may produce *genetic* effects and may show up in future generations. Genetic defects and mutations, while not positively identified in humans, have been observed in some animal studies.

The effect of radiation depends on the amount absorbed. Temporary effects such as vomiting might be caused by an instantaneous dose of 100-200 rem, but with no long-lasting side effects. At 50 rem a single instantaneous dose might cause a reduction in white blood cell count. The West Valley Demonstration Project work force is limited to 0.1 rem for individual daily work exposures, not to exceed 1 rem per calendar quarter. At such low exposures no clinically observable effects have ever been seen. The calculated doses from Project operations for the maximally exposed off-site individual is about one twenty-thousandth of a rem or 0.051 millirem.

The difficulty in assessing biological damage from radiation is that other factors can cause the same symptoms as radiation exposure. Moreover, the body apparently is able to repair damage caused by low-level radiation.

The effect most often associated with exposure to relatively high levels of radiation is an increased risk of cancer. However, scientists have not been able to demonstrate that exposure to low-level radiation causes an increase in deleterious biological effects, nor have they been able to determine if there is a level of radiation exposure below which there are no biological effects.

Measuring Radiation at the West Valley Demonstration Project

Human beings are exposed to radioactivity primarily through air, water, and food. At the West Valley Demonstration Project all three pathways are monitored, but air and surface water pathways are the two major means by which radioactive material can move off-site.

The geology of the site (kinds and structures of rock and soil), the hydrogeology (water presence and flow), and meteorological characteristics of the site (windspeed, patterns, and direction) are all considered in evaluating potential exposure through the major pathways.

Monitoring Program

The on-site and off-site monitoring program at the West Valley Demonstration Project includes measuring the concentration of total alpha and beta radioactivity, conventionally referred to as "gross alpha" and "gross beta," in air and water effluents. Measuring the total alpha and beta radioactivity in several samples, which can be done within a matter of hours, produces a comprehensive picture of current on-site and off-site radiation levels from all sources. In a facility such as the West Valley Demonstration Project, tracking the overall levels of radioactivity in effluents is an important tool in maintaining acceptable operations.

Other radioactive elements are measured, of course. Strontium-90 and cesium-137 are measured because of their relative abundance in WVDP waste streams. Certain radionuclides such as tritium or iodine-129 are not sufficiently energetic to be detected with the gross alpha and beta measurements, so these must be analyzed separately with instruments having greater sensitivity. Heavy elements such as uranium require special analysis to be detected as they exist at such low levels at the WVDP.

The radionuclides monitored at the Project are those which produce relatively higher doses and/or are most abundant in the air and water effluents and in the animal and plant life. Because sources of radiation at the Project have been decaying for more than fifteen years, the monitoring program does not routinely include short-lived radionuclides, i.e., anything with a half-life of less than five years. (See Appendix A for a schedule of samples and radionuclides measured and Appendix B for related Department of Energy protection standards).

Radioactive Waste Treatment at the West Valley Demonstration Project

The Integrated Radwaste Treatment System (IRTS)

By 1988 the West Valley Project was operating the Integrated Radwaste Treatment System (IRTS), a four-step process that converts high-level radioactive liquid waste stored at the site in underground steel tanks into low-level waste stabilized in cement. The system eventually will remove approximately 90% of the water from the high-level waste tanks and most of the salts.

Half of the radioactivity is in the supernatant or liquid portion of the waste, and the other half is in the sludge on the bottom of the tank. The supernatant is composed mostly of sodium and potassium salts plus water. Dissolved radioactive cesium makes up more than 99% of the total fission products in the supernatant. The largest chemical constituent of the sludge is iron hydroxide, and most of the radioactivity in the sludge is strontium-90.

THE SUPERNATANT TREATMENT SYSTEM (STS), housed in a spare storage tank identical to the one that holds most of the high-level waste, removes more than 99.9% of the radioactive cesium from the liquid by passing it through four ion-exchange columns filled with zeolite. This produces a mildly radioactive liquid salt solution.

THE LIQUID WASTE TREATMENT SYSTEM (LWTS) concentrates the salt solution by evaporation and separates it into radioactive concentrates and a distilled water effluent.

THE CEMENT SOLIDIFICATION SYSTEM (CSS) blends the LWTS concentrates into cement in lined drums which are then stored in the drum cell.

THE DRUM CELL was completed in 1987 to store Class B and Class C low-level radioactive wastes. (See Glossary). The drum cell is a large, shielded structure inside a building which protects the cell and its contents from the weather. It is located southwest of the main plant near the NRC-licensed disposal area. The building can store seventeen thousand 270-liter (71 gallon) square drums of solidified low-level waste.

1989 Monitoring Program at the West Valley Demonstration Project

The following chapters describe in detail the 1989 effluent monitoring and environmental surveillance program at the Project. Several primary factors influenced the West Valley Demonstration Project environmental monitoring program in 1989 :

- The Department of Energy issued Order 5400.1, "General Environmental Protection Program" in late 1988, together with draft documents expanding regulations concerning air emissions.
- Dose assessment methods were revised to maintain consistency and compliance with new guidelines and regulations.
- High- and low-level waste continued to be processed.
- Monitoring of hazardous and radioactive mixed waste was increasingly emphasized.
- Planning for the eventual closing of the West Valley site (Phase II) began with work on site characterization.
- Installation of an extensive groundwater monitoring system began.
- Regulatory agencies with co-jurisdiction over the site cooperated in establishing compliance guidelines.
- Staff and space available for environmental monitoring and analysis were doubled in order to provide even more comprehensive environmental surveillance.

Airborne Emissions

As mandated by Department of Energy Order 5400.1 and amplified in associated draft documents, 1989 saw a greater focus on airborne emissions from DOE facilities at the West Valley Demonstration Project. Ventilation monitoring necessary for the future operation of the vitrification cell was investigated, and National Emission Standards for Hazardous Air Pollutants permitted sources were evaluated for compliance with the stricter rules. Detailed maps showing locations of air discharge points and vented tanks on the premises were prepared to pinpoint the locations of potential sources of airborne radioactive emissions. Interior air concentrations were measured to verify that storage facilities for low-level radioactive wastes were not sources of airborne radioactive emissions. No problem areas were identified.

Dose Assessment

Several improvements in dose assessment methods were implemented in 1989. More sophisticated and accurate models and spreadsheets were adopted for estimating the dose from airborne and liquid effluents. The newer models can be easily adapted to reflect new point sources or changes in limits. A review of meteorological data and of the impact of various metereological factors on the estimation of annual off-site radiation doses from airborne releases was completed in November of 1989. In December another procedural change streamlined computer calculations for predicting off-site concentrations from unplanned airborne releases. These improved methods and models enhance the speed of response in the event of accidental releases.

Processing of Low-level Waste

Throughout 1989 the low-level waste treatment facility (LLWTF) processed aqueous wastes before discharge. In 1989 the Project released 39 million liters (10 million gallons) to the environment. The discharge waters contained an estimated 40.5 millicuries (mCi) of radioactivity (gross alpha plus gross beta). Comparable releases during the previous five years, 1984 through 1988, averaged about 54.5 mCi per year. The 1989 release was roughly 26% below this level. The 3.9 curies of tritium released was almost six times the amount released in 1988, however, and was attributed to normal operation of the STS process.

During the second year of operations of the supernatant treatment system (STS), 246,000 gallons of waste were processed into 4523 cement drums, bringing the total to 7119 drums thus far. Gamma radiation measurements taken around the drum cell suggested no need to place cold drums in the top layer of the storage facility. Calculation of the maximum scattered radiation dose rate to which the public might be exposed indicated no significant risk to public health or safety from this source.

Hazardous and Mixed Wastes

Although the major emphasis in monitoring continues to be on the radiological materials on the site, an increasing emphasis on monitoring hazardous wastes and radioactive mixed wastes focused upon these activities:

- Emergency preparedness in the event that chemicals are released from the site
- Assessments of lead and asbestos on site
- Conducting an inventory of on-site bulk storage tanks
- Testing on-site wastes stored in drums
- Measuring leachate from the state disposal area (SDA)
- Investigating traces of 1,1-dichloroethane in two on-site monitoring wells
- Determining that radioactively contaminated solvent was migrating from the NRC-licensed disposal area (NDA) and beginning an interceptor trench for its containment.

Phase II Site Characterization

A significant part of the preliminary work for the Phase II Site Characterization necessary for closure of the WVDP was completed in 1989. Several draft documents were issued, including the Site Characterization Plan, a Phase II Environmental Impact Statement (EIS) Implementation Plan, and a Phase II Analytical Plan. Initial steps included meeting with the public to discuss the scope of the work for the Phase II EIS, reviewing the literature concerning the geology of the site, and aerial photography and digital topographical mapping of the Project area and selected portions of the Western New York Nuclear Service Center.

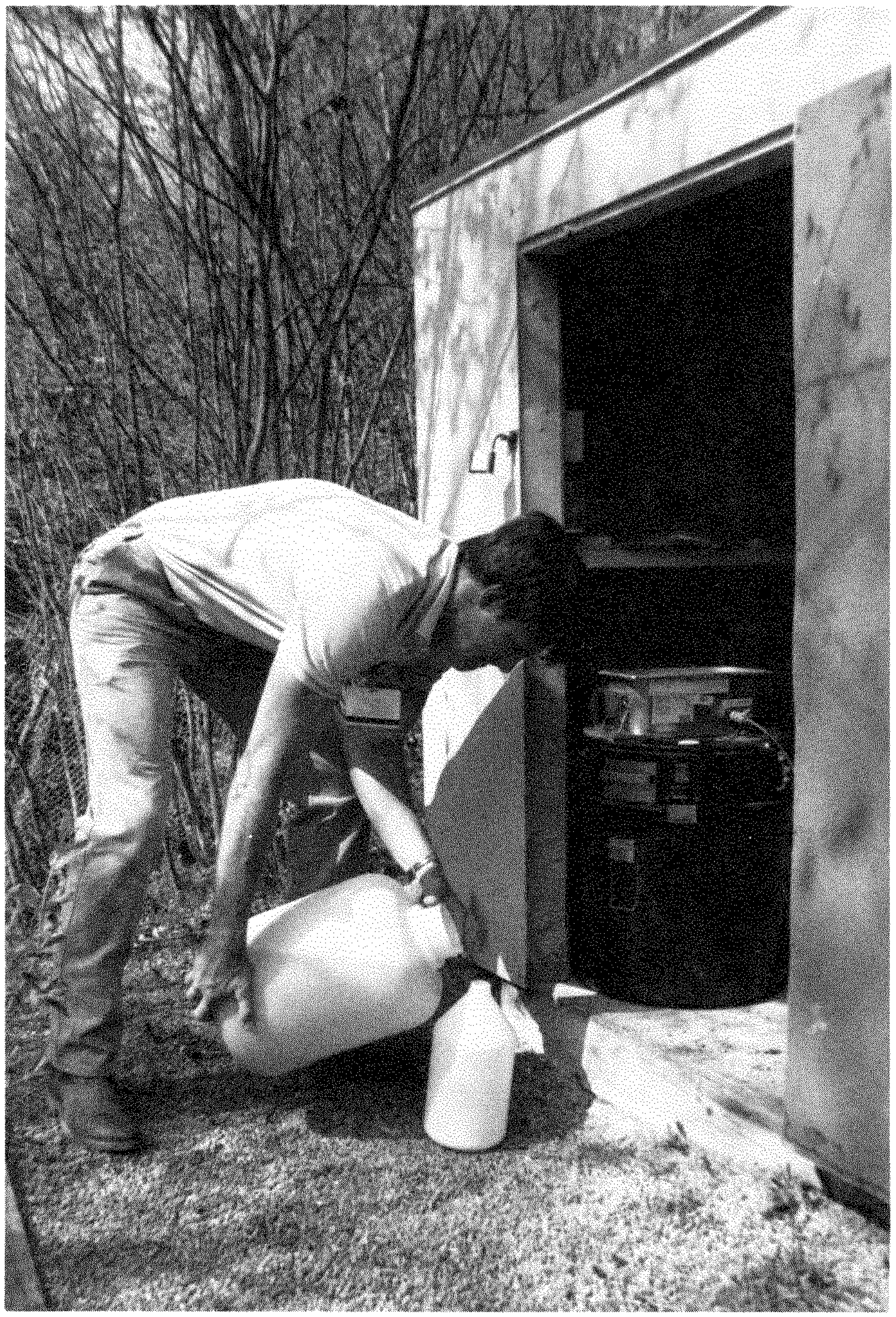
Groundwater Monitoring Program

Throughout 1989 a groundwater monitoring plan was developed to meet Resource Conservation Recovery Act (RCRA) requirements at existing solid waste management units (SWMUs) on-site, as well as to provide necessary information for Phase II (site closure) Site Characterization. An inventory of more than 100 existing monitoring wells produced recommendations on which wells to abandon or retain. Late in the year, a draft of the Sampling and Analysis Plan (SAP) for the groundwater monitoring network was issued. This plan included a review of the geology of the area, a description of the SWMUs on-site, and maps of the locations of monitoring wells up- and downgradient from each of the SWMUs. Drilling for new wells began in October 1989, with 35 wells of a planned total of 62 new wells completed by the end of the year. When the network of new wells is completed in mid-1990 it will actually include more than 70 wells.

Regulatory Agencies

Continued compliance with federal and state regulations was a primary concern in 1989. Discussions with the New York State Department of Environmental Conservation and the U.S. Environmental Protection Agency on the requirements for handling mixed waste led in November to the beginning of negotiations to resolve potential regulatory issues concerning mixed waste. The guidelines developed identified Phase II-related issues requiring agreement among West Valley Nuclear Services Co. , the Department of Energy, and the New York State Energy Research and Development Authority and suggested a schedule for completion of the Phase II National Environmental Policy Act processes.

Several appraisals of the West Valley Demonstration Project related to environment, safety, and health (ES & H) were conducted by the Department of Energy during 1989. These reviews included a technical safety appraisal (TSA) of the Project, a "Tiger Team" investigation of the site, and visits from the Federal Bureau of Investigation and the Environmental Protection Agency. Environmental reviewers evaluated all aspects of the sampling and measurement program conducted by the laboratory staff. (See Appendix A). According to the *Environmental Safety And Health Management And Organization Compliance Assessment*, DOE/EH-0114, "The Assessment Team did not identify any problems at the WVDP that present any undue risk to public or worker health or the environment."



COLLECTING A COMPOSITE SURFACE WATER SAMPLE

2.0 Effluent and Environmental Monitoring

2.1 Air Monitoring

2.1.1. Radiological Monitoring

In 1989 airborne particulate radioactive samples were collected continuously at five locations around the perimeter of the site and at four remote locations at Great Valley, West Valley, Springville, and Dunkirk, New York. (See Figure 2-1). Perimeter locations are on Fox Valley Road, Rock Springs Road, Route 240, Thomas Corners Road, and Dutch Hill Road. These locations were chosen to provide data from places most likely to provide the highest concentrations, based on meteorological observations in the area. The remote locations provide data from nearby communities and from natural background areas.

Sample Collection

Air samples are collected by drawing air through a very fine filter with a vacuum pump. The total volume of air drawn through the sampler is measured and recorded by a meter. The filters trap particles of dust which are then tested in the laboratory for radioactivity. At two locations (AFRSPRD and AFGRVAL)samples are also collected for iodine-129 using activated carbon cartridges. Three of the perimeter samplers, mounted on towers four meters high, maintain an average air flow of about 40 L/min (1.5 ft^3/min) through a 47-mm glass fiber filter. The remaining perimeter samplers and the four remote samplers operate with the same air flow rate as the three mounted on towers, but the sampler head is set at 1.7 meters above the ground, the height of the average human breathing zone.

Concentrations measured at Great Valley (AFGRVAL, 29 km south of the site) and Dunkirk (AFDNKRK, 50 km west of the site) are considered to be representative of natural background radiation. Data from these samplers are provided in Appendix C-2, Tables C-2. 18 and C-2.19.

Filters from all samplers were collected weekly and analyzed after a seven-day "decay" period to remove interference from short-lived naturally occurring radioactivity.

In addition, quarterly composites consisting of thirteen weekly filters from each sample station were analyzed. Gross alpha and gross beta measurements of each filter were made using a low-background gas proportional counter. A complete tabulation of these stations is given in Tables C-2. 12 through C-2.20 in Appendix C-2.

Radioactivity Concentrations

The average monthly concentrations ranged from 1.09E-14μCi/mL to 8.23E-14μCi/mL(4.0E-4 Bq/m^3 to 3.0E-3 Bq/m^3) of beta activity and 5.25E-16 μCi/mL to 4.12E-15μCi/mL (1.9E-5 Bq/m^3 to 1.5E-4 Bq/m^3) of alpha activity. Iodine-129 was not detected at either location AFRSPRD or AFGRVAL, as shown in Tables C-2.13 and C-2.18 in Appendix C-2.

In all cases, the measured monthly gross activities were well below 3E-12 μCi/mL beta and 2E-14 μCi/mL alpha, the most stringent acceptable limits (referred to as Derived Concentration Guides, or DCGs)set by the Department of Energy for any of the isotopes present at the WVDP. Department of Energy standards and DCGs for radionuclides of interest at the West Valley Demonstration Project can be found in Appendix B.

Annual data for the three samplers which have been in operation since 1983 average about 1.98E-14 μCi/mL (7.3E-4 Bq/m^3) of gross beta activity in air. The annual average gross beta concentration at the Great Valley background station was 2.1E-14 μCi/mL (7.8E-4 Bq/m^3) in 1988, and averaged 2.04 E-14 μCi/mL (7.5E-4 Bq/m^3) in 1989.

Global Fallout

Global fallout is also sampled at four of the perimeter air sampler locations. Material from open pots located near the samplers is collected and analyzed every month. The 1989 data from these analyses are found in Appendix C-2, Tables C-2.21

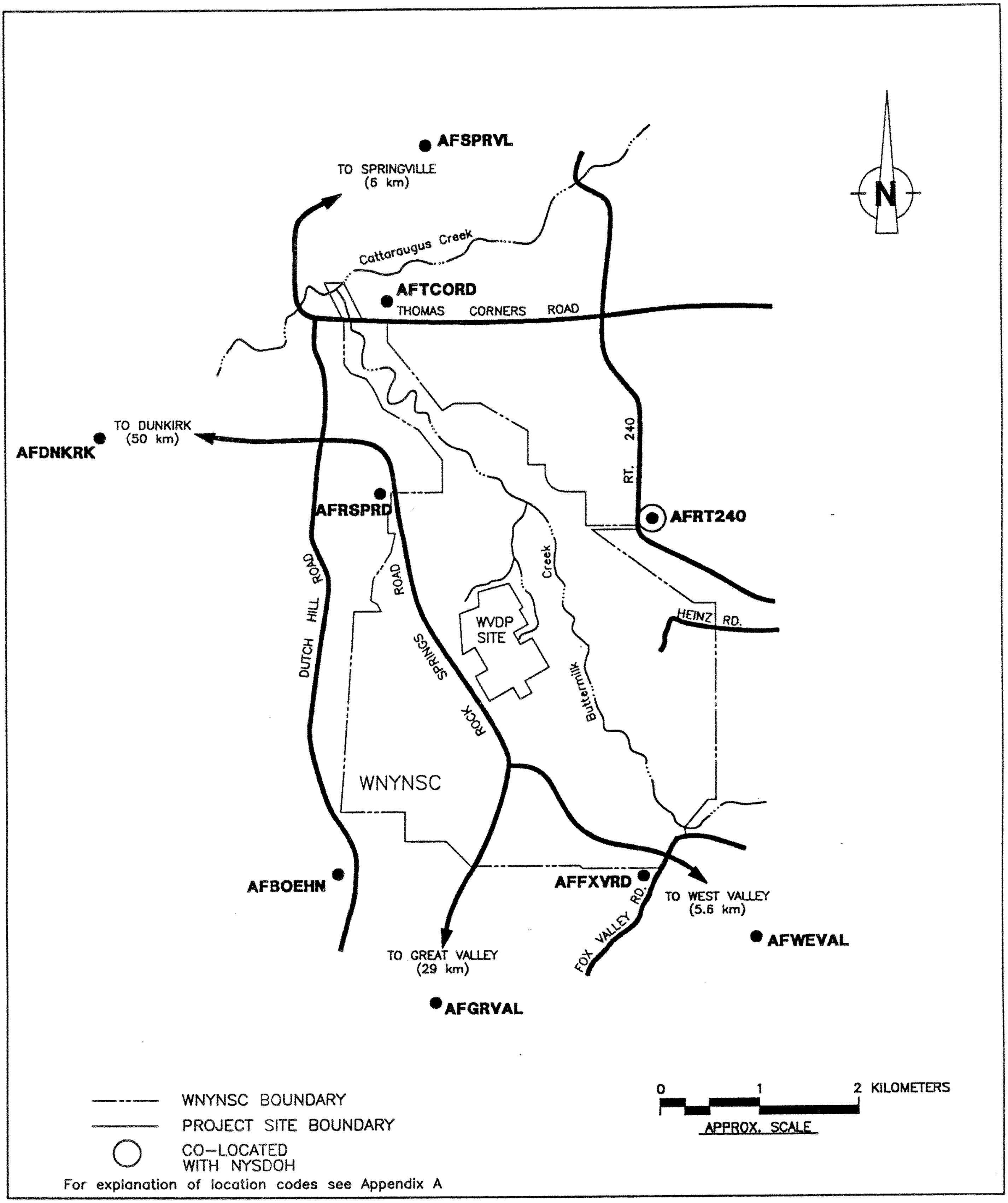


Figure 2-1. Off–Site Air Sampler Locations.

and C-2.22. These collections indicate short-term effects. Results from these measurements are reported in nCi/m^2 per month for gross alpha and beta. These reporting units indicate a rate of deposition rather than the actual concentration of activity within the collected water. Long-term deposition is measured by surface soil samples collected annually near each sampling station. The data will be published in next year's report.

Ventilation Systems

The exhaust from each ventilation system serving the site facilities is continuously filtered, monitored, and sampled as it is released to the atmosphere. Specially designed isokinetic nozzles continuously remove a representative portion of the exhaust air which then is drawn through very fine, small, glass-fiber filters to trap any particles. Sensitive detectors that continuously measure the radioactivity on these filters provide remote readouts of alpha and beta radioactivity levels to control display panels. A separate stack monitoring sample unit on each system provides another filter that is removed every week and subjected to additional laboratory testing.

This sampling system also contains an activated carbon cartridge used to collect a sample for iodine-129. Water vapor from the plant stack is collected by trapping moisture on silica gel desiccant columns. The trapped water is then distilled from the silica gel desiccant and analyzed for tritium.

Because tritium and iodine concentrations are quite low, the large-volume samples collected weekly from the plant stack provide the only practical means of determining the amount of specific radionuclides released from the facility.

The main ventilation stack (ANSTACK) sampling system remained the most significant airborne effluent point in 1989. A high sample collection flow rate through multiple intake nozzles ensures a representative sample for both the weekly filter and on-line monitoring system. Variations in monthly concentrations of airborne radioactivity reflect the level of Project activities within the facility. (See Appendix C-2, Table C-2.1). However, at the point of discharge, average radioactivity levels were already below concentration guides for airborne radioactivity in an unrestricted environment. (See Appendix C-2, Table C-2. 3). Further dilution from the stack to the site boundary reduces the concentration by an average factor of about 200,000.

The total quantity of gross alpha, gross beta , and tritium released each month from the main stack, based on weekly filter measurements, is shown in Appendix C-2, Table C-2. 1. The results of analyses for specific radionuclides in the four quarterly composites of stack effluent samples are listed in Table C-2. 2.

Sampling systems similar to the main stack system monitor airborne effluents from the cement solidification system ventilation stack (ANCSSTK), the contact size reduction facility ventilation stack (ANCSRFK), and the supernatant treatment system ventilation stack (ANSTSTK). The 1989 samples showed detectable gross radioactivity, including specific beta and alpha emitting isotopes, but did not approach any Department of Energy effluent limitations. (See Tables C-2. 4 through C-2.9 in Appendix C-2).

Three other operations are routinely monitored for airborne radioactivity releases: the low-level waste treatment facility (ANLLWTF), the contaminated clothing laundry (ANLAUNV), and the supercompaction volume reduction system (ANSUPCV). Results for the supercompaction volume reduction system are found in Tables C-2. 10 and C-2. 11.

The total amount of radioactivity discharged from facilities other than the main ventilation stack is less than 1% of the airborne radioactivity released from the site and is not a significant factor in the airborne pathway in 1989.

2.1.2. Nonradiological Monitoring

Nonradiological emission and plant effluents are controlled and permitted under New York State and U.S. Environmental Protection Agency regulations. The WVDP operated ten stationary sources of airborne effluents in 1989. An additional permit pertaining to a source of airborne effluents generated from the construction of the vitrification off-gas system is presently inactive because construction has been completed. Cold-testing of the vitrification off-gas system was completed in April 1989. Subsequently, in November 1989, the corresponding permit was discontinued. The permits are for minor sources of regulated pollutants including particulates, nitric acid mist, oxides of nitrogen, and sulfur. However, because of their insignificant concentrations and small mass discharge, monitoring of these parameters is not required.

The individual air permits held by the WVDP are identified and described in Appendix C-5, Table C-5.1.

2.2 Surface Water and Sediment Monitoring

2.2.1 Radiological Monitoring

Four automatic samplers collect surface water at points along the site drainage channels. Water collection points were chosen at locations most likely to show any radioactivity released from the site and at a background station upstream of the site.

Sample Collection

The samplers draw water through a tube extending to an intake below the stream surface. An electronically controlled battery-powered pump first blows air through the sample line to clear any debris. The pump then reverses to collect a sample, reverses again to clear the line, and then resets itself. The pump and container are housed in a small insulated and heated shed to allow sampling throughout the year.

An off-site sampler (WFFELBR) on Cattaraugus Creek at Felton Bridge just downstream of the confluence with Buttermilk Creek, the major surface drainage from the Western New York Nuclear Service Center (Figure 2-2), periodically collects an aliquot (a small volume of water, approximately 100 mL/hour) from the creek. A chart recorder keeps track of the stream depth during the sample period so that a flow-weighted weekly sample can be proportioned into a monthly composite based on relative stream depth. Gross alpha, beta, and tritium analyses are performed each week, and the composite is analyzed for strontium-90 and gamma-emitting isotopes.

In addition to the Cattaraugus Creek sampler, two surface water monitoring stations are located on Buttermilk Creek. Samplers collect water from a background location upstream of the Project (WFBCBKG) and from a location at Thomas Corners Road downstream of the plant and upstream of the confluence with Cattaraugus Creek (WFBCTCB). These samplers collect a 25 mL aliquot every half-hour. Samples are retrieved biweekly, composited monthly, and analyzed for tritium, gross alpha, and gross beta radioactivity. A quarterly composite of the biweekly samples is analyzed for gamma-emitting isotopes and strontium-90.

The fourth station (WNSP006) is located on Frank's Creek where Project site drainage leaves the security area (Figure 2-3). This sampler collects a 50 mL aliquot every half-hour. The sample is retrieved weekly, analyzed for tritium, gross alpha and beta radioactivity, and composited monthly. The monthly composite is analyzed for strontium-90 and gamma-emitting isotopes. A quarterly composite is analyzed for carbon-14, iodine-129, and alpha-emitting isotopes.

Tabulated data from surface water samplers are provided in Appendix C-1, Tables C-1.3 through C-1.7.

Radioactivity Concentrations

Radiological concentration data from these sample points show that average gross radioactivity concentrations generally tend to be higher in Buttermilk Creek below the WVDP site, presumably because of the small amount of activity from the site which enters via Frank's Creek. The range of gross beta activity, for example, was 1.4E-9 to 6.1E-9 μCi/mL (5.2E-2 to 2.3E-1 Bq/L) upstream in Buttermilk Creek at Fox Valley (WFBCBKG), and from 2.3E-9 to 1.6E-8 μCi/mL (8.5E-2 to 5.9E-1 Bq/L) in Buttermilk Creek at Thomas Corners Bridge (WFBCTCB). (See Tables C-1.3 and C-1.4). Concentrations below the site are only marginally higher than background concentrations upstream of the site, and only during months of Lagoon 3 discharge. Despite monthly values showing site influence on Cattaraugus Creek and Felton Bridge, yearly averages for Cattaraugus Creek are not significantly higher than background (Buttermilk Creek upstream), based on statistical evaluation.

In comparison, if the most restrictive beta-emitting radionuclide is used (iodine-129), the maximum concentration measured in Buttermilk Creek at Thomas Corners Bridge where dairy cattle have access is 3.2% of the Department of Energy's derived concentration guide (DCG) for unrestricted use. (See Appendix B for a list of acceptable concentration limits). At the Project security fence more than four kilometers from the nearest

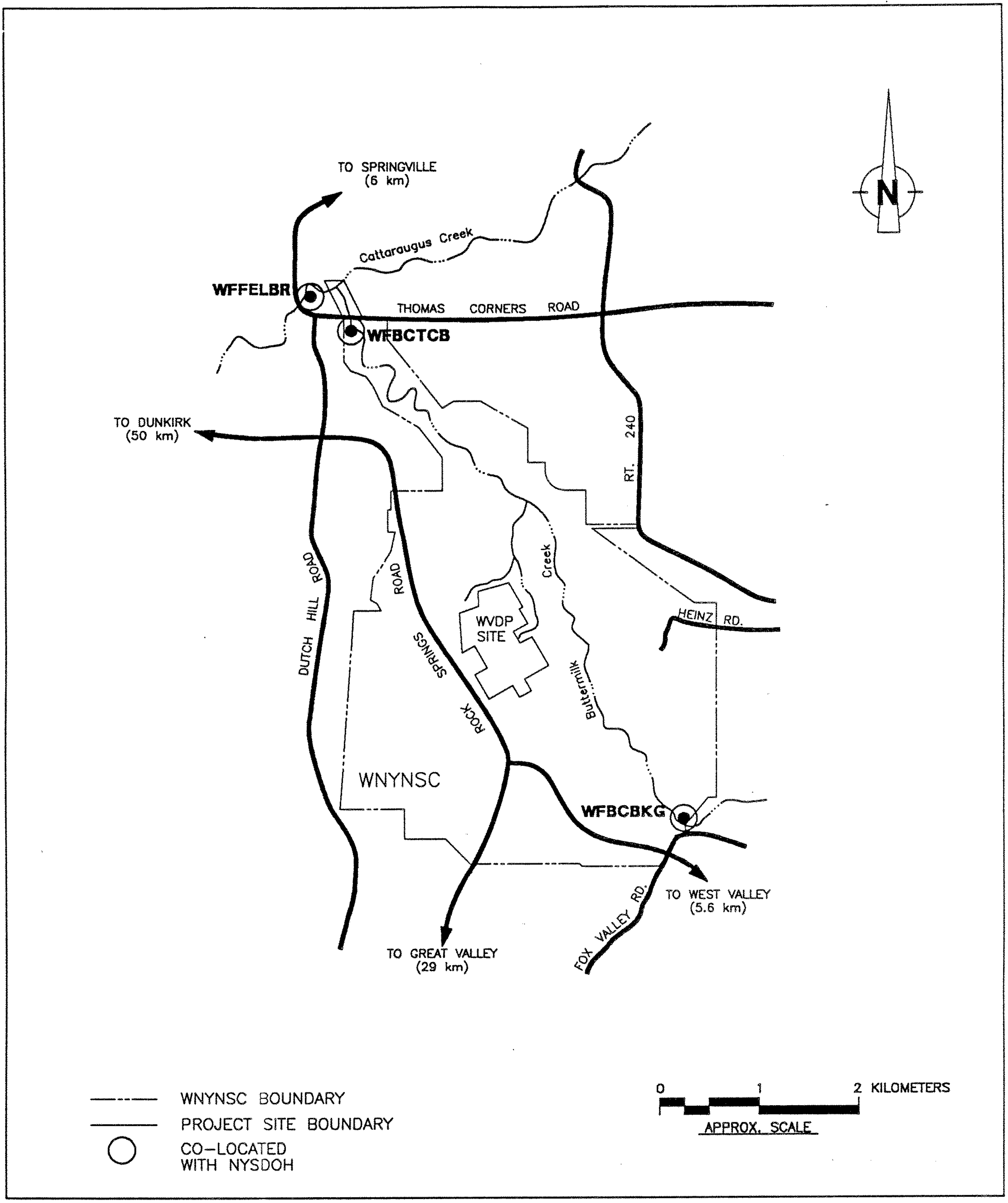


Figure 2-2. Sampling Locations for Off-Site Surface Water.

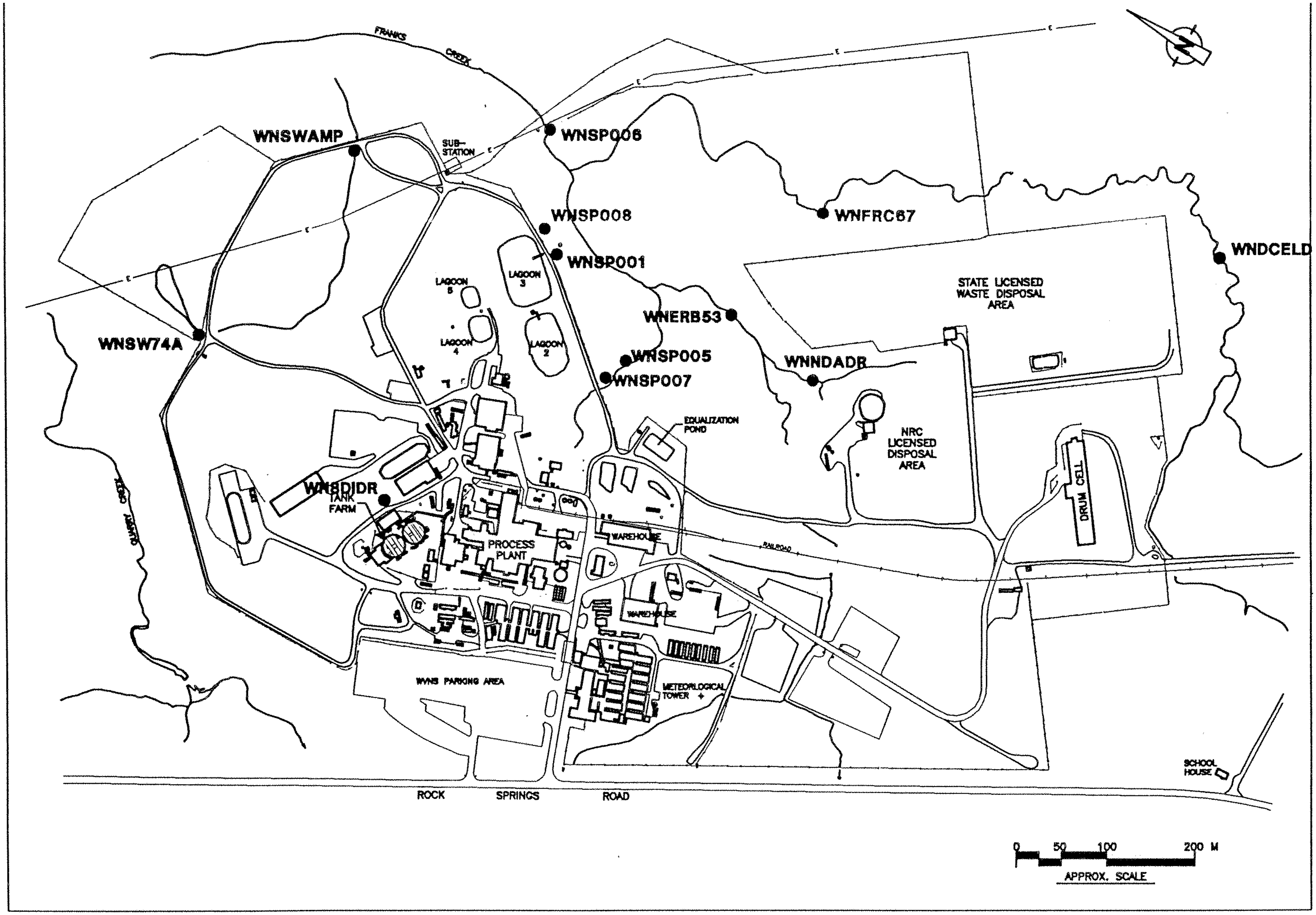


Figure 2-3. Sampling Locations for On–Site Surface Water.

public access point, the most significant beta-emitting radionuclides were measured at 9.4E-8 μCi/mL (3.5 Bq/L) for cesium-137 and 2.2E-8 μCi/mL(8.1E-1 Bq/L) for strontium-90 during the period of highest concentration. This corresponds to 3.1% and 2.2% of the DCGs for cesium-137 and strontium-90, respectively. The annual average was 1.7% for cesium and 1.6% for strontium. Tritium, at an annual average of 4.3E-6 μCi/mL (1.6E2 Bq/L), was 0.2% of the DCG values. Except for three months of the year, the gross alpha was below the average detection limits of 1.5E-9 μCi/mL (5.6E-2 Bq/L), or less than 5% of the DCG for americium-241. The positive values were 21% of the DCGs in October and 6% of the DCGs in March and November, assuming that all alpha-emitting isotopes were americium-241.

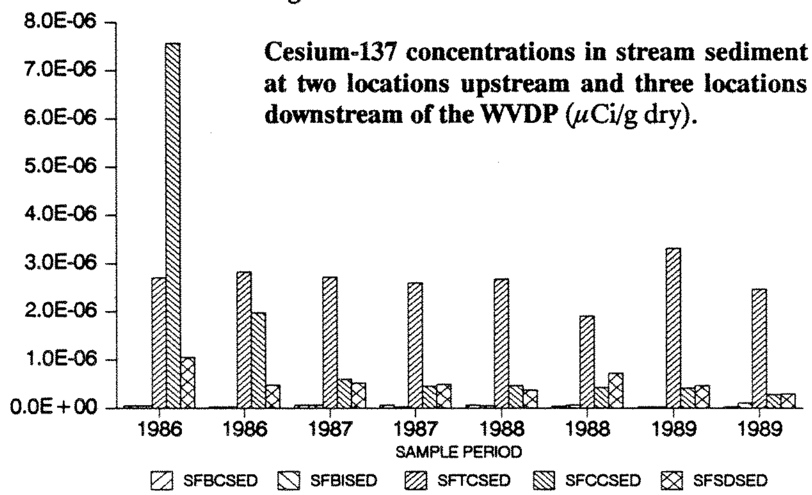


Figure 2-4.

Cesium-137 concentrations in stream sediment at two locations upstream and three locations downstream of the WVDP (μCi/g dry).

The highest concentrations in monthly composite water samples from Cattaraugus Creek during 1989 show strontium-90 to be less than 0.9% of the DCGs for drinking water. No gamma-emitting fuel cycle isotopes were detected in Cattaraugus Creek water during 1989 (Table C-1.7).

The largest single source of radioactivity released to surface waters from the Project is the discharge from the low-level waste treatment facility (LLWTF) through the Lagoon 3 weir (WNSP001, Figure 2-3) into Erdman Brook, a tributary of Frank's Creek. There were four batch releases totaling about 39 million liters in 1989. The effluent was grab sampled daily during the 43 days of release and analyzed. The total amounts of radioactivity in the effluent are listed in Table C-1. 1. Of the activity released, 1.7% of the tritium and 3.9% of the other gross radioactivity originated in the New York State disposal area (based on measurements of water transferred in 1989 from the state area to the LLWTF) and not from previous or current Project operations (See Table C-1. 10). The annual average concentrations from the Lagoon 3 effluent discharge weir, including all measured isotope fractions, were less than 30% of the DCGs (Table C-1. 2 in Appendix C-1).

Results of sediment sampling from streams above and below the Project are shown in Table C-1. 9. These results are similar to those obtained for gamma-emitting nuclides during 1988. A comparison of 1986-1989 cesium-137 data for the two upstream locations and the three downstream locations is found in Figure 2-4. As indicated, cesium-137 concentrations are decreasing or staying constant with time for the locations downstream of the project (SFTCSED, SFCCSED, and SFSDSED). Concentrations of cesium-137 in upstream locations have remained consistent throughout the time period. A comparison of cesium-137 to naturally occurring potassium-40 as shown in Figure 2-5 for the downstream location nearest the Project (SFTCSED) indicates that cesium-137 is present at levels lower than naturally occurring gamma emitters.

2.2.2. Nonradiological Monitoring

Liquid discharges are regulated under the State Pollutant Discharge Elimination System (SPDES). The WVDP holds a SPDES permit which identifies the outfalls where liquid effluents are released to

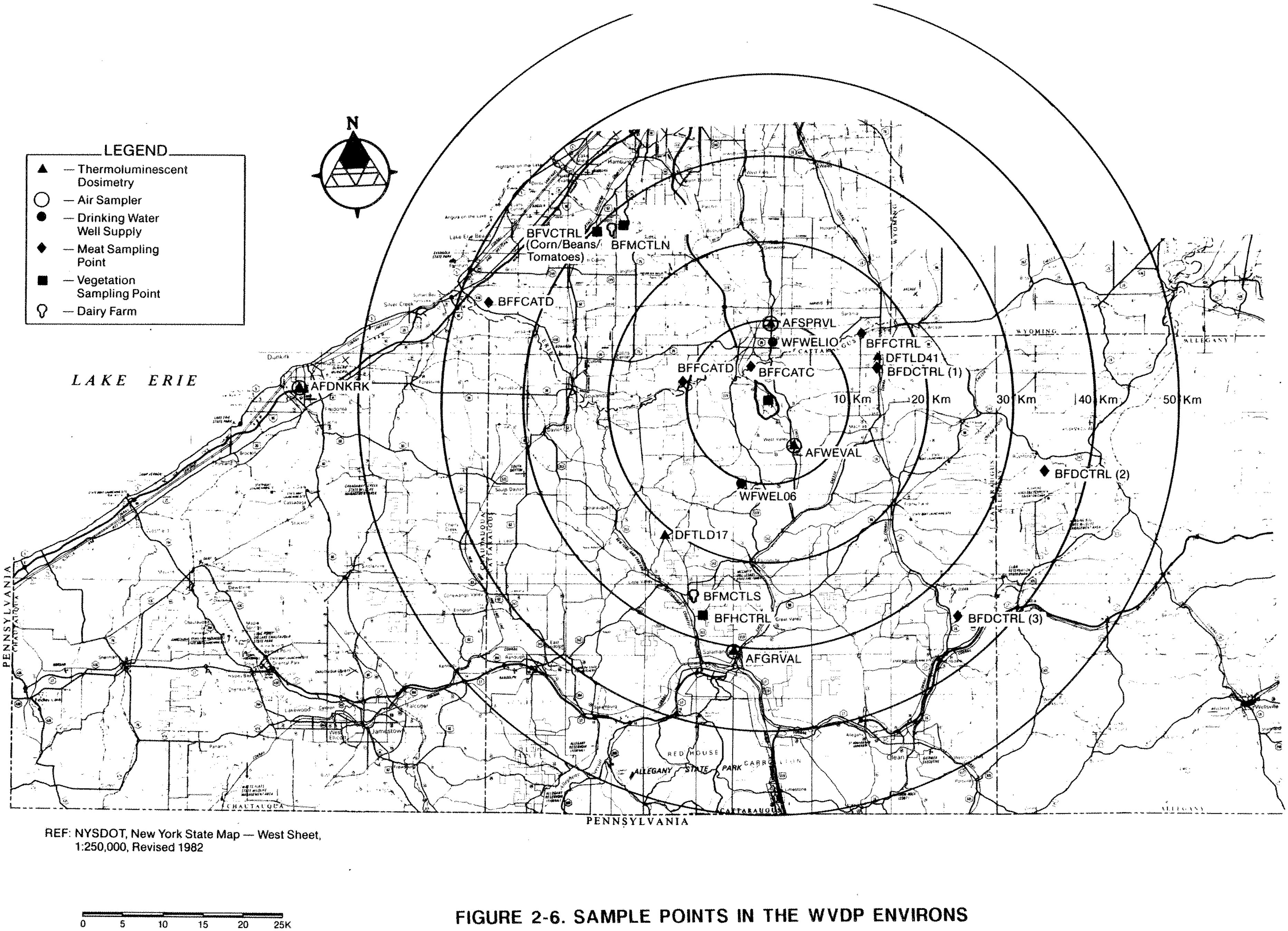


FIGURE 2-6. SAMPLE POINTS IN THE WVDP ENVIRONS

control and downstream samples revealed no significant differences between sample locations. The log-normal statistical treatment of the fish data presented in Table C-3.4 is appropriate to the sample type being reported. (USDOE, DOE/EP-0023, 1981).

Venison

Specimens from an on-site deer herd were analyzed for radioactive components. The average concentration of strontium-90 and cesium-137 in the venison showed little deviation from 1988 levels, assumed to be background for the area. Data from control, or background, deer samples collected in 1989 indicated again only little deviation from expected background. Both sets of 1989 data are shown in Table C-3.2 for comparison.

Meat and Milk

The concentration of strontium-90 in beef samples from near-site farms appeared slightly elevated compared to control samples. However, cesium-137 was elevated in control samples as compared to those collected near the site. (See Table C-3.2 in Appendix C-3).

Milk samples were taken in 1989 from dairy farms near the site (Figure 2-7) and from control farms at some distance. Besides the quarterly composite sample from the maximally exposed herd to the north (BFMREED), an additional quarterly composite of milk was taken from a nearby herd to the northwest (BFMCOBO). Single samples were taken from herds to the south (BFMWIDR) and southwest (BFMHAUR). Two samples from control herds (BFMCTLN and BFMCTLS) were also collected as quarterly composites. Each sample or composite was analyzed for strontium-90, tritium, iodine-129, and gamma-emitting isotopes (Table C-3.1). Strontium-90 in samples from near the site ranged from 1.E-9 to 4.8E-9 μCi/mL (4.1E-3 to 1.8E-2 Bq/L) compared to the control samples at 2.0E-9 to 4.1E-9 μCi/mL(7.4E-3 to 1.5E-2 Bq/L). Iodine-129 was not detected in any samples to the lower limit of detection (LLD) of 8E-10 μCi/mL (3.0E-3Bq/L). Although tritium values above detection limits were seen in milk samples taken from near-site farms in 1989, higher values were seen in samples taken from distant control locations.

Fruit and Vegetables

Based on the samples analyzed in 1989 (Table C-3.3), there was no detectable difference in the concentration of tritium, strontium-90, or gamma-emitting isotopes in corn, beans, or tomatoes grown either near the site or at remote locations.

2.4 Direct Environmental Radiation

The current monitoring year, 1989, was the sixth full year in which direct penetrating radiation was monitored at the West Valley Demonstration Project using TL-700 lithium fluoride (LiF) thermoluminescent dosimeters (TLDs) located as shown on Figures 2-6, 2-8 and 2-9. The uncertainty of individual results and averages were acceptable and measured exposure rates were comparable to those of 1988. There were no significant differences in the data collected from the background TLDs (Locations 17, 23, 34, and 41) and from those on the WNYNSC perimeter for the 1989 reporting period.

Dosimeters used to measure ambient penetrating radiation during 1989 were processed on-site. The system used Harshaw TL-700 LiF chips which are used solely for environmental monitoring apart from the occupational dosimetry TLDs. The environmental TLD package consists of five TLD chips laminated in a thick card bearing the location identification and other information. These cards are placed at each monitoring location for one calendar quarter (3 months) and then processed to obtain the integrated gamma radiation exposure.

Monitoring points are located around the site perimeter and access road, at the waste management units, at the inner facility fence, and at background locations remote from the WVDP site. Appendix C-4 provides a summary of the results for each of the environmental monitoring locations by calendar quarter along with averages for comparison.

The quarterly averages and individual location results show very slight differences due to seasonal variation, and the data obtained for all four quarters compared favorably to the respective quarterly data in 1988 with no unusual situations observed. The sixteen perimeter TLD average was 19.4 milliroentgen (18.6 mrem) in 1989. A comparison of the perimeter TLD quarterly averages since 1983 is shown in Figure 2-10. Presumably because of their

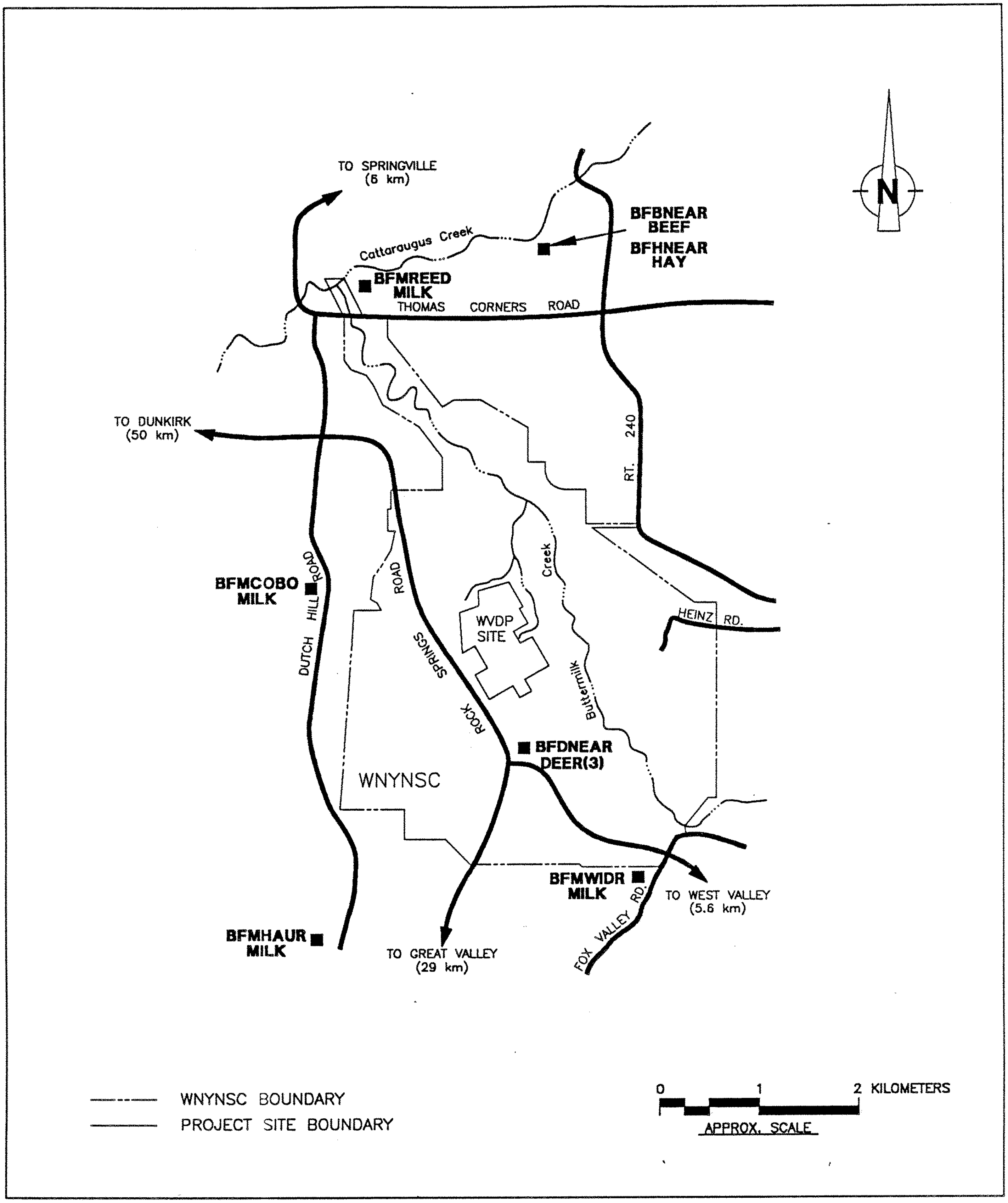


Figure 2-7. Biological Samples Taken Near the WVDP.

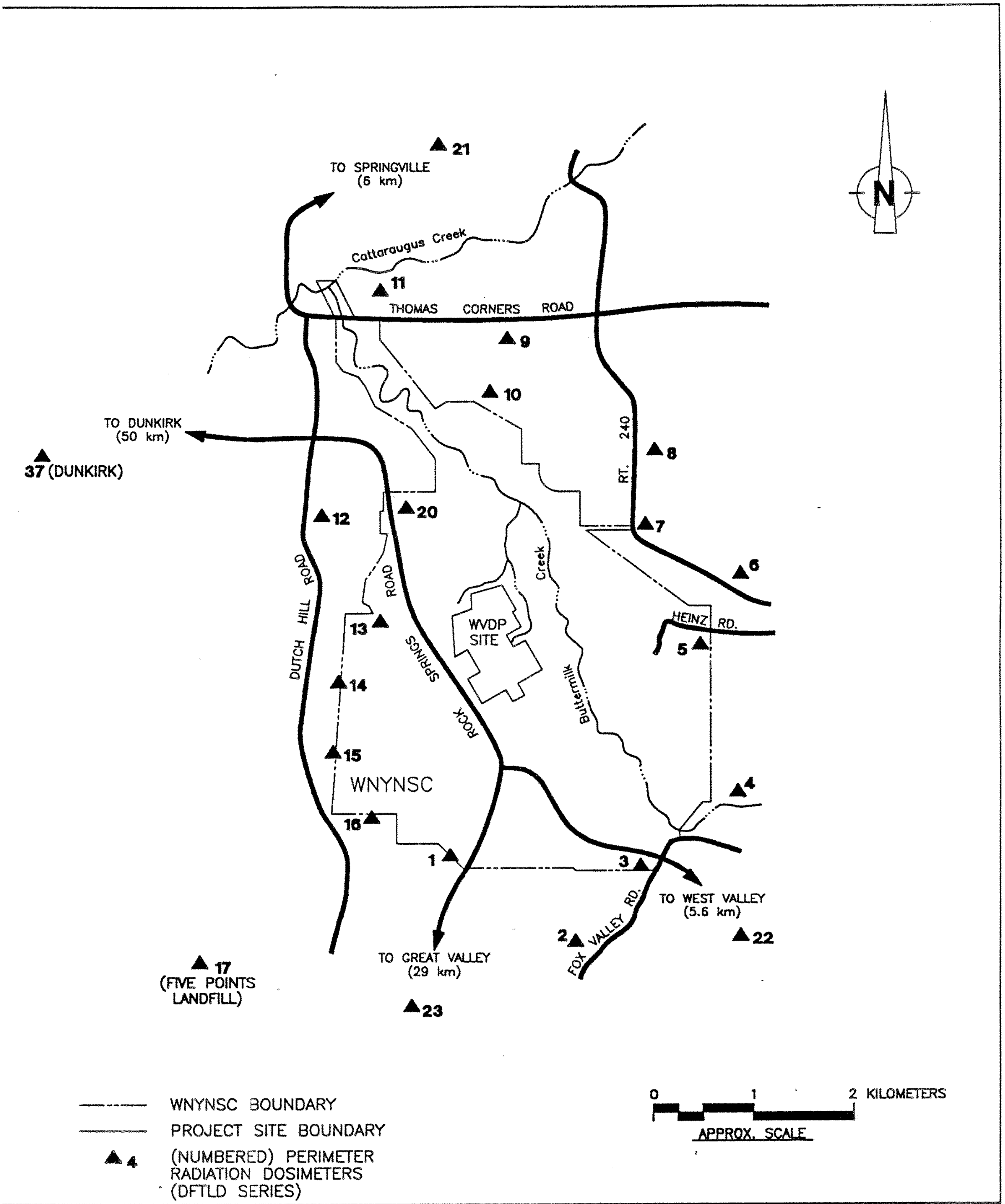


Figure 2-8. Location of Perimeter Thermoluminescent Dosimetry (TLD).

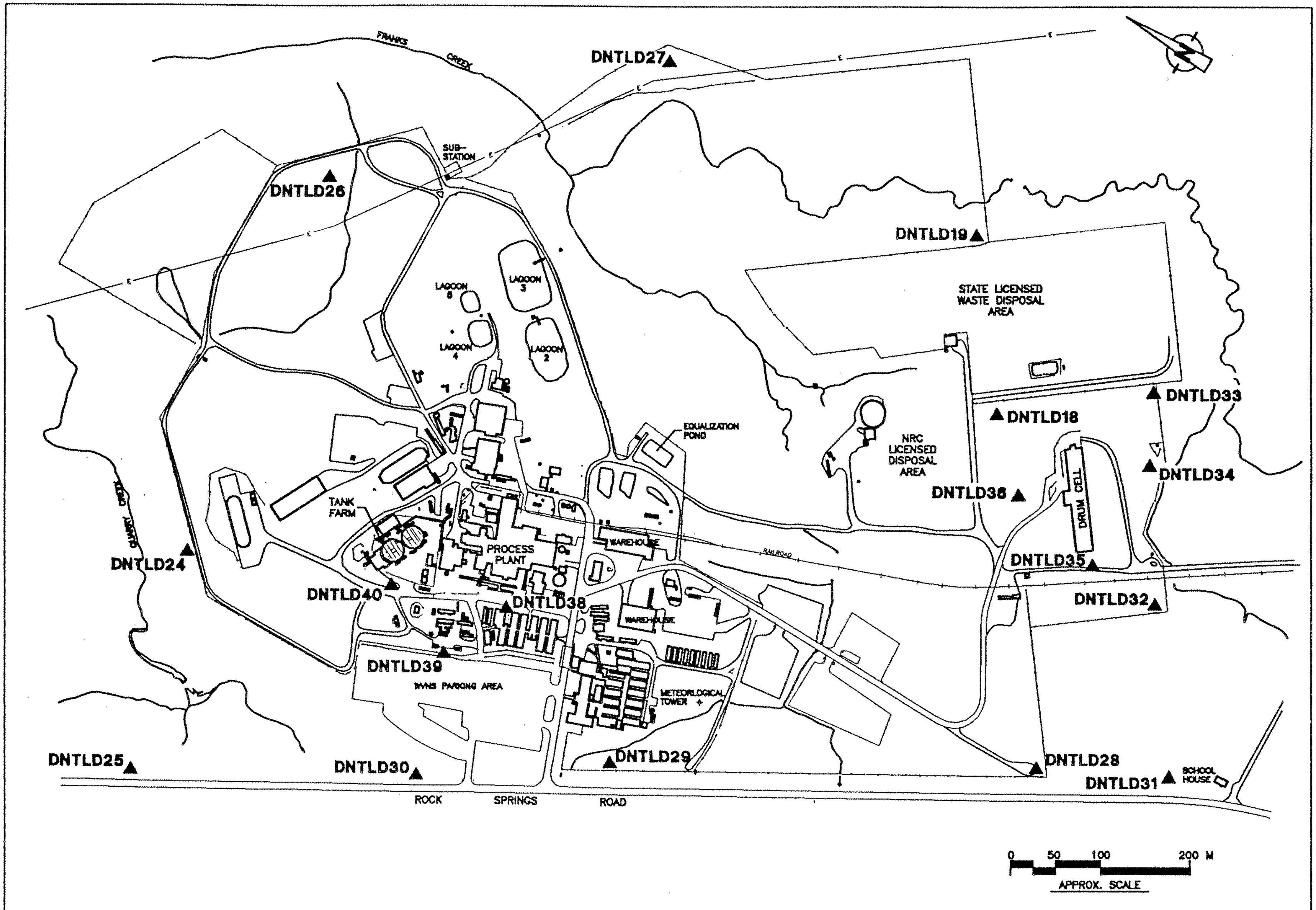


Figure 2-9. Location of On-Site Thermoluminescent Dosimetry (TLD)

proximity to the low-level waste disposal area, the dosimeters at locations 18 and 19 showed a small elevation in radiation exposure compared to the WNYNSC perimeter locations. Although above background, the readings are relatively stable from year to year. Location 25, on the public access road through the site north of the facility, also showed a small elevation above background because decontamination wastes are stored near location 24 within the inner facility fence.

Location 24 on the north inner facility fence, like Locations 18 and 19, is not included in the off-site environmental monitoring program; however, it is a co-location site for one NRC TLD. (See Appendix D, Table D-6). This point received an average exposure of 0.67 milliroentgens (mR) per hour during 1989, which is primarily attributable to the nearby storage of sealed containers of radioactive components and debris from plant decontamination efforts. The storage area is well within the WNYNSC boundary (as are locations 18 and 19) and not readily accessible to the public. TLD locations 26 through 36 are located along the Project security fence, forming an inner ring of monitoring around the facility area. TLDs 37 through 40 were added in 1987 to monitor a third background location and to improve coverage of waste management units and on-site sources respectively. TLD 41 in Sardinia, approximately 20 km to the east of the Project, was added in 1989 to monitor a fourth background location. Figures C-4.1 and C-4.2 in Appendix C show the location average for off-site and on-site TLDs respectively.

2.5 Pollution Abatement

Major pollution control and abatement activities in 1989 included completing two projects that had been started in 1988: THE WVDP SPILL PREVENTION, CONTROL, AND COUNTERMEASURES PLAN (SPCC) revision, which was completed in January, and the ASBESTOS INSPECTION REPORT AND MANAGEMENT PLAN, which was issued in draft form in February 1989 and which included a site-wide characterization of asbestos-containing building materials.

Four other projects completed the 1989 pollution abatement efforts:

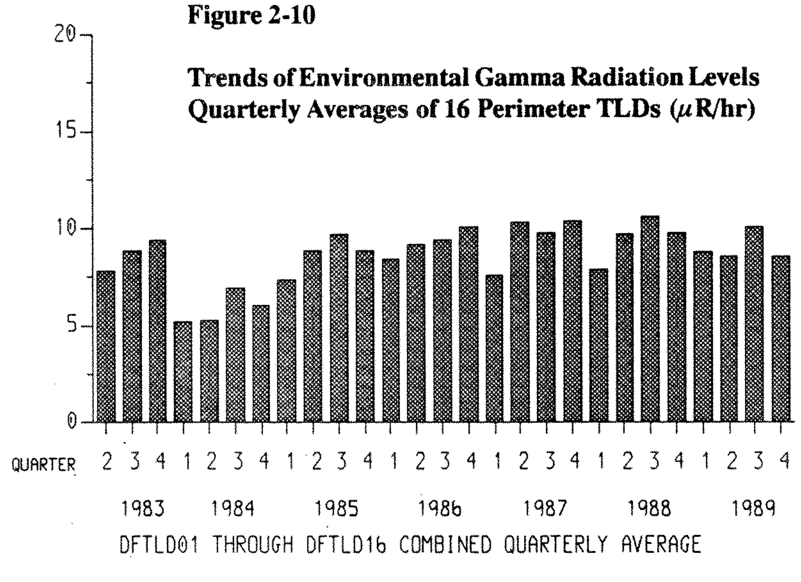
- The equalization basin outfall was fitted in midsummer with a shutoff valve sensitive to pH variations in order to control the variations in pH which occasionally would result in effluent water with a pH beyond the permitted limits. A pH detector in the basin shuts the drain by a remote actuator if the pH approaches the limit in either direction and an alarm notifies the system operators that the valve is shut so that they can adjust and put the system back on-line without violating the outfall permit conditions.

- The water treatment system's nonradioactive sludge settling pond outfall, previously routed to the utility drainage ditch, was diverted to the equalization basin. This was to have been finished during construction of the equalization basin but was not completed until November of 1989.

- A major testing program to qualify a method of reducing the nitrogen oxides emissions from the vitrification process was completed in 1989, resulting in an acceptable design that will control future nitrogen oxides emissions. Although this technology is to be applied to a system still under construction, it represents a considerable effort toward reducing potential pollution at the source.

Figure 2-10

Trends of Environmental Gamma Radiation Levels Quarterly Averages of 16 Perimeter TLDs (μR/hr)



- Another notable accomplishment was an inventory of all the chemical storage tanks so that applicable tanks could be registered with NYSDEC. Necessary upgrades were identified and scheduled. The updated inventory was included in a new revision of the SPCC issued in March 1990.

2. 6 Special Monitoring

2. 6. 1 Drum Cell Radiation Monitoring

During 1989 liquid high-level waste (supernatant from Tank 8D-2) processed by the Integrated Radwaste Treatment System (IRTS) produced approximately 4500 71-gallon drums of cement-solidified waste. These drums were added to the more than 2500 drums placed in the IRTS drum cell in 1988, for a total of more than 7000.

Most of the gamma radiation emitted from these drums is shielded by the drum cell walls. However, some radiation is emitted through the roof of the drum cell, which is unshielded. This radiation scatters in air and adds to the existing naturally occurring gamma-ray background.

Radiation exposure levels were monitored at various locations around the drum cell perimeter and at the closest location accessible by the public (300 meters west at Rock Springs Road). Baseline measurements were taken in 1987 and 1988 before placing the drums. Two types of measurements were taken: instantaneous, using a high pressure ion chamber (HPIC), and cumulative, using thermoluminescent dosimeters (TLDs).

The strength of the gamma-ray field can vary considerably from day to day because of changes in meteorological conditions, as evidenced by the two sets of HPIC readings taken during 1989. TLD measurements provide a more accurate estimate of long-term changes in the radiation field since they integrate the radiation exposure over an entire calendar quarter. Even such quarterly readings show evidence of a seasonal cycle. Annual variability in background radiation levels can depend on such factors as average temperature, air pressure, humidity, precipitation (including snow cover), and solar activity during a particular year.

Two sets of quarterly TLD measurements were taken at the Rock Springs Road locations nearest the drum cell. These measurements and locations are identified as TLD 28 and 31 in Table C-4. 1 in Appendix C-4 and Figure 2-9 above.

To assess any increase in the radiation field contributed at Rock Springs Road by the 7000–plus drums in the drum cell, the two sets of four quarterly measurements were summed and an average annual exposure rate of 82 mR/year was obtained. This value was compared to the average pre-drum cell background rate of 86 mR/year recorded during 1987-1988. The net contribution from the drum cell activities during 1989 therefore can not be distinguished from the annual variations in natural background.

2. 6. 2 Solvent Contamination

In November 1983, organic contamination was encountered in a USGS series 82 groundwater monitoring well near the NRC–licensed solid radioactive waste disposal area (now referred to as the NDA). Waste organic solvent containing a kerosene mixed with tributyl phosphate had been buried in tanks during operation of the reprocessing facility. Wells were drilled from 1984 to 1986 to monitor and recover the solvent from the disposal area. The apparent movement of solvent away from the buried location in 1988 initiated more extensive monitoring and characterization of the area.

Changes in the organic solvent levels that were observed in some wells monitored in November 1989 by the WVNS Waste Management group renewed concerns of migration.

Nonroutine sampling of well 85-I-9, a six-inch diameter PVC- cased well, and 89-5-N and 89-14-E, both two-inch steel-cased wells, began in early December 1989. These wells were selected because of their geographic proximity to surface drainage, adequacy of water volume with respect to the total sample volume needed, and the urgent need to perform sampling and analysis within a short time. Additionally, 85-I-9 was selected because it had recently undergone changes in the organic level and it contained sufficient water to allow complete sampling without regard to recharge rate. Wells 89-5-N and 89-14-E were selected also because their steel casings were not likely contribute to trace organic contamination as a PVC casing might.

An effort was made to sample only the aqueous phase of each well. However, because the sampling mechanism had to pass through the organic layer before reaching the aqueous layer, some of the overlying organic material was collected also. Because of unacceptably slow recharge rates of wells throughout the NDA all sampling occurred without prior well water purging. The well samples were submitted for a variety of analyses including volatile organics, semivolatile organics, pesticides, PCBs, and tributyl phosphate. A sufficient amount of sample material from 85-I-9 was available to allow additional testing for metals, biological and chemical oxygen demand, water quality, and selected radiological and nonradiological parameters. A "field blank" water sample was also submitted and a "laboratory blank" was provided by the testing lab. (A field blank is a sample of reagent grade water taken to the collection site and introduced to the sample container in the same manner as the samples. A laboratory blank is reagent grade water processed and analyzed as a sample, along with the actual samples. Blanks serve to determine if inadvertent contamination is being introduced during the process of sample collection, preparation, and analysis).

A subcontracted laboratory capable of handling organically and radiologically contaminated materials analyzed the samples. Results were first made available in late December 1989. The bulk of analyses yielded results below analytical detection limits with a few notable exceptions. A summary of the positive results can be found in Appendix E, Table 15.

Additional positive results were reported for a variety of unknown compounds, mainly saturated hydrocarbons. The testing laboratory performed a computer search of the National Institute of Standards and Technologies (NIST) Library before declaring these materials "unknown." The maximum concentration of any of the unknown compounds has been tentatively estimated at 2100 μg/L in well 85-I-9. The total concentration of all unkown compounds in well 85-I-9, mainly hydrocarbons, is estimated at 9200 μg/L. It is believed that these compounds originated from the organic solvent used during reprocessing operations. Although these concentrations are significant, they do not represent EPA-identified priority pollutants. Remediation efforts have continued in 1990 to ensure no off-site releases of these contaminants.

The relative significance of the presence of the organic material reported is not readily understood at this time. Confirmation of organic migration patterning and extent will require additional testing and analysis.

2.6.3 Closed Landfill Maintenance

Closure of the on-site nonradioactive construction and demolition debris landfill (CDDL, formerly the "cold dump") was completed in August 1986. The landfill area was closed in accordance with NYSDEC requirements for this type of landfill, following a closure plan (Standish, 1985) approved by NYSDEC. The closed facility was routinely inspected and maintained as specified by the closure requirements, including checking the closure area for proper drainage (i.e., no obvious ponding or soil erosion) and cutting the grass planted on the soil and clay cap. Groundwater monitoring in the area of the closed landfill is described in section 3.2.2.2.

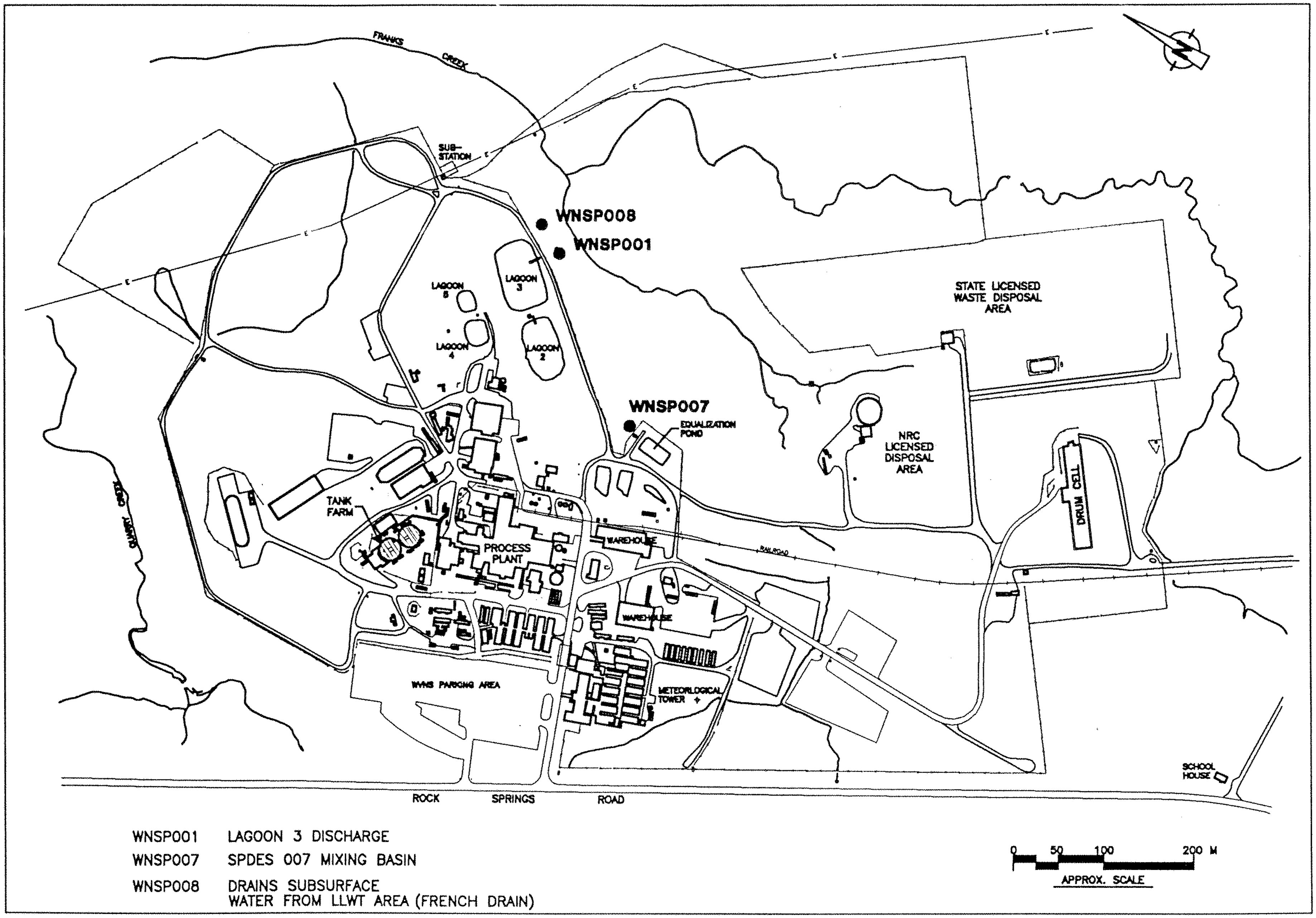


Figure 2-11. SPDES Monitoring Points.

COLLECTING A GROUNDWATER SCREENING SAMPLE

3.0 Groundwater Monitoring

3.1. Geology of the West Valley Site

3. 1. 1 Geologic History

At the northern border of Cattaraugus County in southwestern New York, the West Valley Demonstration Project is located on the well-dissected and glaciated Allegheny Plateau. The area is drained by Cattaraugus Creek, which is part of the Great Lakes – St. Lawrence watershed (Tesmer, 1975). Most of the geology affecting the site is the result of recent events in the earth's history, including repeated glaciation that occurred throughout the Pleistocene epoch 1.6 million to ten thousand years ago.

The WVDP rests immediately on a thick sequence of glacial deposits which range in thickness from 1.5 to 150 meters (5 to 500 ft.). These are underlain by an ancient bedrock valley consisting of upper Devonian shales and siltstones of the Canadaway and Conneaut Groups which dip southward at about 0.5^{o} (Rickard, 1975). Total relief in the area is approximately 396 meters (1,300 ft.), with summits reaching 732 meters (2,400 ft.) above sea level.

Oscillations of the Laurentide ice sheet during the ice ages define four major stages of ice advance and retreat. The last one, of greatest concern here, was the Wisconsin stage (Broughton et al., 1966).

The lowermost glacial unit underlying the site, the Kent till, was deposited about 19,000 years ago, toward the end of the Wisconsin glaciation. At this time the ancestral Buttermilk Creek Valley was covered with ice. As the glacier began to recede, debris formerly trapped in the ice was left behind, impounding Buttermilk Creek Valley, which soon filled with melt water from the receding glacier, forming a temporary proglacial lake. As the ice continued to melt, more material washed out, filling the new lake with the lacrustrine and Kame Delta deposits that overlie the Kent till. Continued recession of the glacier ultimately led to drainage of the proglacial lake and exposure of its sediments to erosion (LaFleur, 1979).

Between 16,000 and 15,000 years ago the ice began its last advance (Albanese et al., 1984). Material from this advance covered the Kame Delta and lacustrine deposits with as much as 40 meters (130 ft.) of till. This newer unit, the Lavery till, is the uppermost unit throughout most of the site, with a thickness of 24 meters (80 ft.) at the waste burial areas. Its subsequent retreat left behind another proglacial lake which ultimately drained, allowing Buttermilk Creek to flow again. Postglacial alluvial fans were deposited on the western part of the Lavery till (beneath the plant area) bringing to a close the Pleistocene geology of the site (LaFleur, 1979).

3. 1. 2 Hydrogeology

The site can be divided into two regions: a north plateau on which the plant and its associated facilities reside, and a south plateau which contains the two waste burial areas. (See Figures 3-1 and 3-2).

The uppermost unit in the south plateau is the Lavery till, a very compact, gray silty clay with occasional pods of silt to fine sand. Below this is a sequence of more permeable lacustrine silt and sand, which in turn overlies the less permeable Kent till.

The north plateau differs from the south in that it has a 1- to 10- meter (3- to 30-ft.) sequence of alluvial sand and gravel that blankets the area and a 1- to 10-meter (3-to 30-ft.) till – sand sequence located in the Lavery till.

The depth to the groundwater on the north plateau varies from 0 to 5 meters (0 to 16 ft.), being deepest at the process building and intersecting the surface farther north towards the security fence. Most of the groundwater in the north plateau moves horizontally in the alluvial sand and gravel unit from an area southwest of the process building to the northeast, southeast, and east; minor amounts percolate downward to the underlying Lavery till. Discharge of north plateau groundwater occurs at seepage points along the banks of Frank's Creek, Erdman Brook, and Quarry Creek and at the wetlands near the northern perimeter of the security fence. Hydraulic conductivity of the alluvial sand and gravel unit averages 4.6×10^{-3} cm/sec (Bergeron et al., 1987).

The south plateau water table occurs in the upper 3 meters (0 to 10 feet) of the Lavery till. Groundwater flow in this unit is for the most part vertical, proceeding downward from overlying saturated

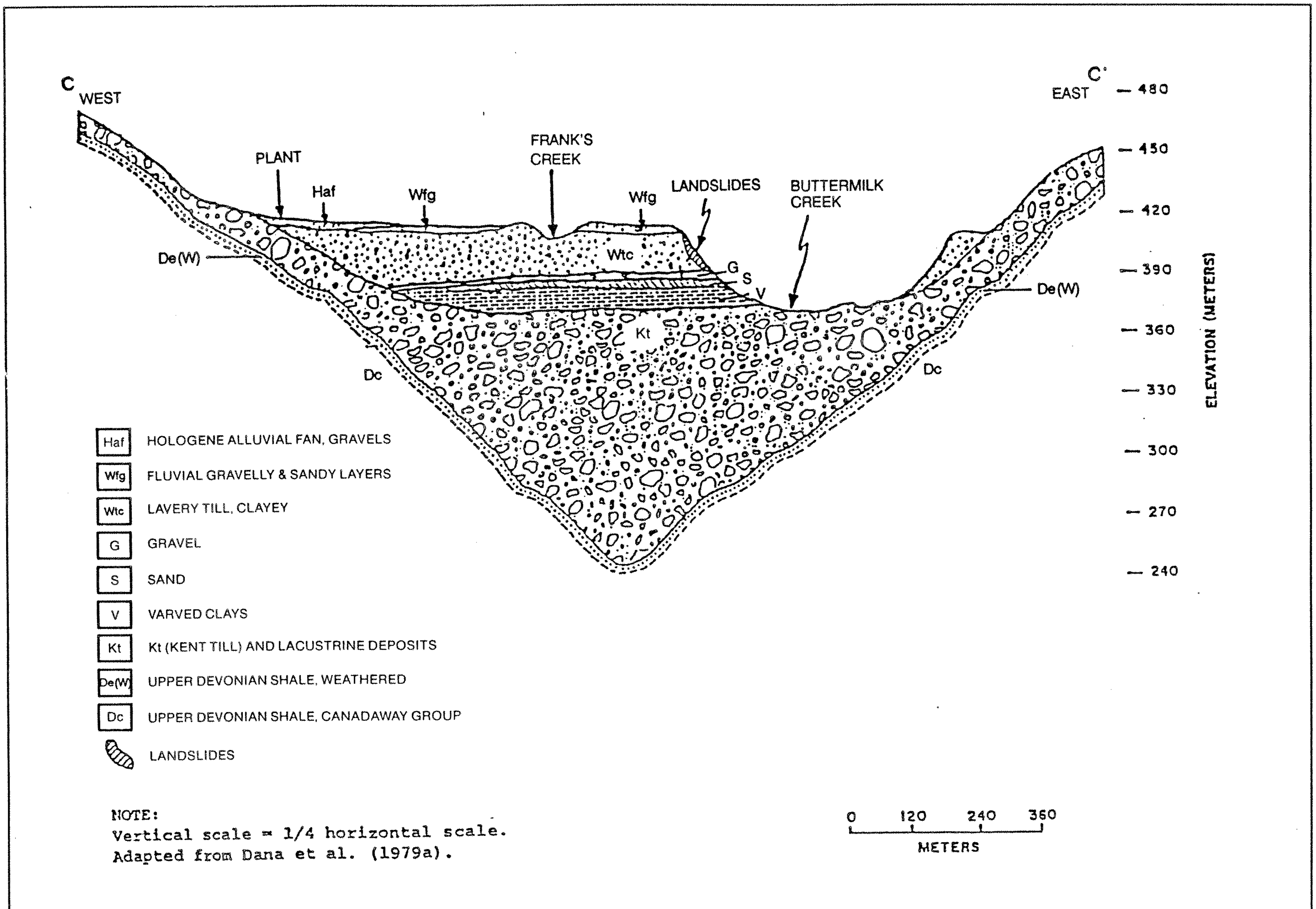


Figure 3-1. Geological Cross-Section Through the North Plateau.

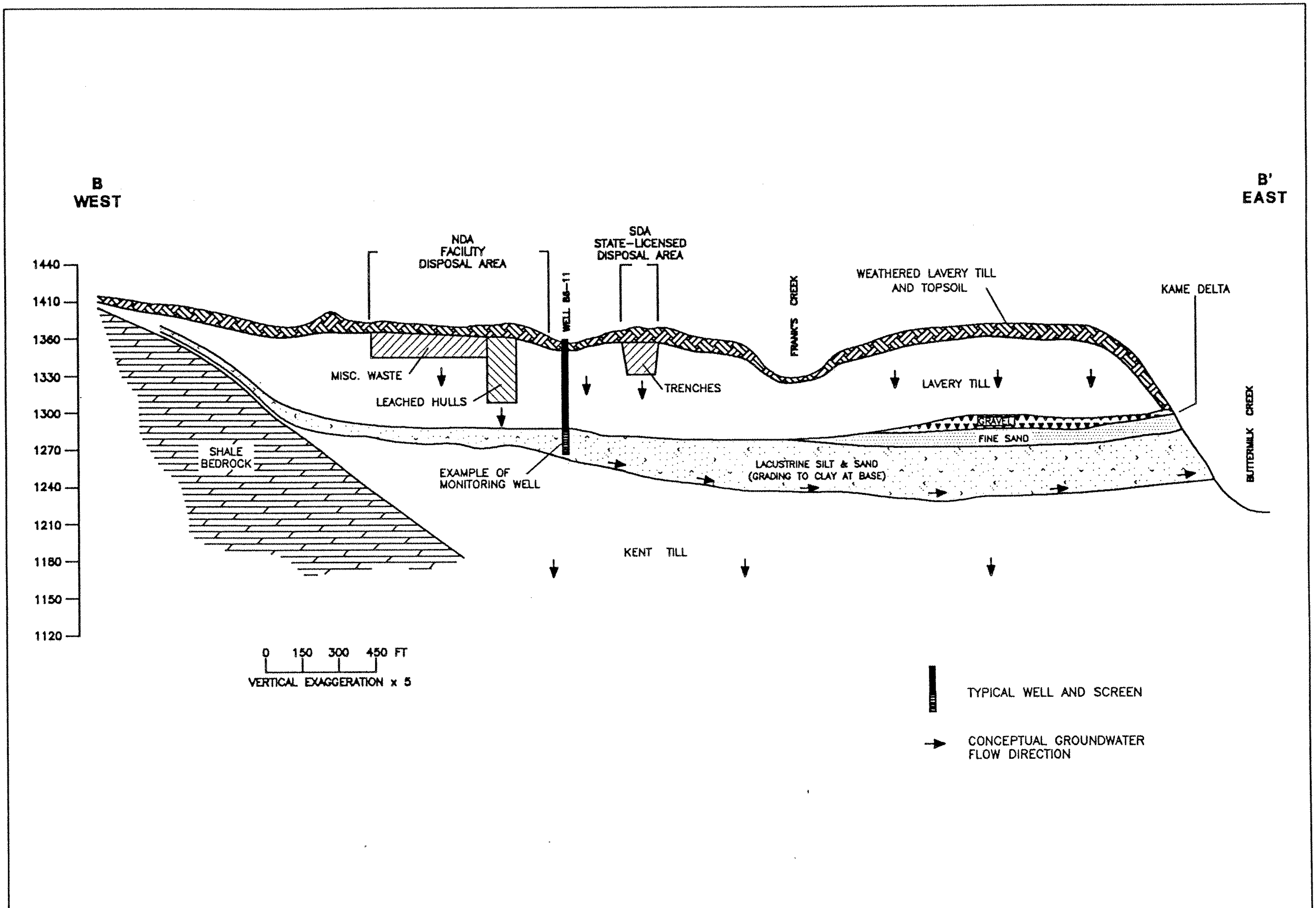


Figure 3-2. Geological Cross-Section Through the South Plateau.

layers to underlying unsaturated layers and ultimately to the lacustrine unit. The weathered portion of the Lavery does exhibit horizontal flow, which enables groundwater to move laterally before moving downward or discharging to local land-surface depressions or stream channels.(Bergeron and Bugliosi, 1988). Some laterally moving water eventually percolates downward to recharge the underlying unweathered till. Hydraulic conductivities in the weathered and unweathered Lavery till average 4.9×10^{-8} cm/sec and 2.8×10^{-8} cm/sec respectively (Bergeron et al., 1987).

The lacustrine silt and sand is a semiconfined aquifer which is recharged from the bedrock to the west. Water levels in piezometers completed in this unit suggest a small lateral flow gradient (23m/km) northeastward toward Buttermilk Creek. Minor recharge also occurs from the overlying Lavery till, making this unit a possible conduit of Lavery discharge to Buttermilk Creek. The lacustrine silt and sand unit is underlain by the Kent till (LaFleur, 1979).

3.2 Groundwater Monitoring Program Overview

The West Valley Demonstration Project's groundwater monitoring program for 1989 included two on-site programs: 1) monitoring three identified solid waste management units using statistical data analysis techniques to detect contamination; 2)monitoring older wells to maintain historical records (see Figure 3-3); and one off-site program monitoring off-site residential drinking water. (See Figure 3-4).

3. 2. 1 On-Site Waste Management Monitoring Network

A network of fourteen wells, a groundwater seep, and the outlet of a french drain monitored the three waste management units listed below for contaminant migration:

- the low-level radioactive waste lagoon system
- the high-level waste tank complex
- the NRC-licensed disposal area.

In each waste management unit one upgradient well, representative of background groundwater conditions, was monitored. Additional well sampling locations were in those downgradient areas most likely to intercept any groundwater contamination. Upgradient and downgradient locations were selected based upon groundwater flow patterns and proximity to any other potential sources of contamination.

Sample Collection

During 1989 eight separate samples were collected from each of the wells surrounding the three waste management units. Four samples were collected during the first half of the year and the remaining four samples were collected during the second half of the year. Before each semiannual sample collection, the depth to the water was measured using an electronic sounding device. A small volume of sample was also collected at the same time in order to evaluate the radiological conditions of the well water prior to sample collection. The sounding measurement was used, along with the total well depth and diameter, to calculate the total volume of standing water within the well casing.

At the time of sampling, three well casing volumes of water are pumped (purged) from each well before sample collection. (At least one well casing volume is removed if the well pumps dry). Purging effectively removes stagnant water from the well casing and draws fresh groundwater into the well so that a representative groundwater sample may be collected. After the well is adequately purged it is ready to be sampled. Table 3-1 lists the parameters for which samples are collected. Measurements of pH and specific conductivity, made at the beginning and end of the sampling, indicate the homogeneity of the sample collected.

Following collection from a given location, the samples are placed in a cooler for return to the site environmental laboratory where they are logged in and preserved. Samples to be analyzed by off-site laboratories are packaged and either delivered by laboratory personnel or shipped via overnight courier. Samples analyzed by on-site laboratories are held in controlled storage until time of analysis.

Table 3 - 1

Schedule of Groundwater Sampling and Analysis

Category	*Parameter*	*New York State Groundwater Quality Standard in mg/L*	*Comment*
I. EPA Interim Drinking Water Standards	Arsenic	0.025	Quarterly for first year; annually thereafter except coliform and pesticides
	Barium	1.0	
	Cadmium	0.01	
	Chromium	0.05	
	Fluoride	1.5	
	Lead	0.025	
	Mercury	0.002	
	Nitrate (as N)	10.0	
	Selenium	0.01	
	Silver	0.05	
	Gross Alpha	15.0 pCi/L	
	Gross Beta	1000 pCi/L 8 pCi/L Sr-90	
	Coliform bacteria		Not analyzed
	Endrin		
	Lindane		
	Methoxychlor		
	Radium		
	Toxaphene		
	2,4-D		
	2,4,5-TP Silvex		
II. Groundwater Quality Indicators	Chloride	250	Quarterly for first year; annually thereafter
	Iron	0.3	
	Manganese	0.3	
	Phenols	0.001	
	Sodium	<20	
	Sulfate	250	
III. Groundwater Contamination Indicators	Nitrate	10	
	pH	6.5-8.5	Four separate samples collected per semiannual period
	Conductivity	Not listed	
	Total Organic Carbon	Not listed	
	Total Organic Halogens	Not listed	
	Specific Metals	As above	
	Tritium	20,000 pCi/L	
	Gross Alpha	15 pCi/L	
	Gross Beta	1,000 pCi/L 8 pCi/L Sr-90	
	Specific Gamma Emitters	Not listed	
IV. Groundwater Elevations			Once before collecting each well sample

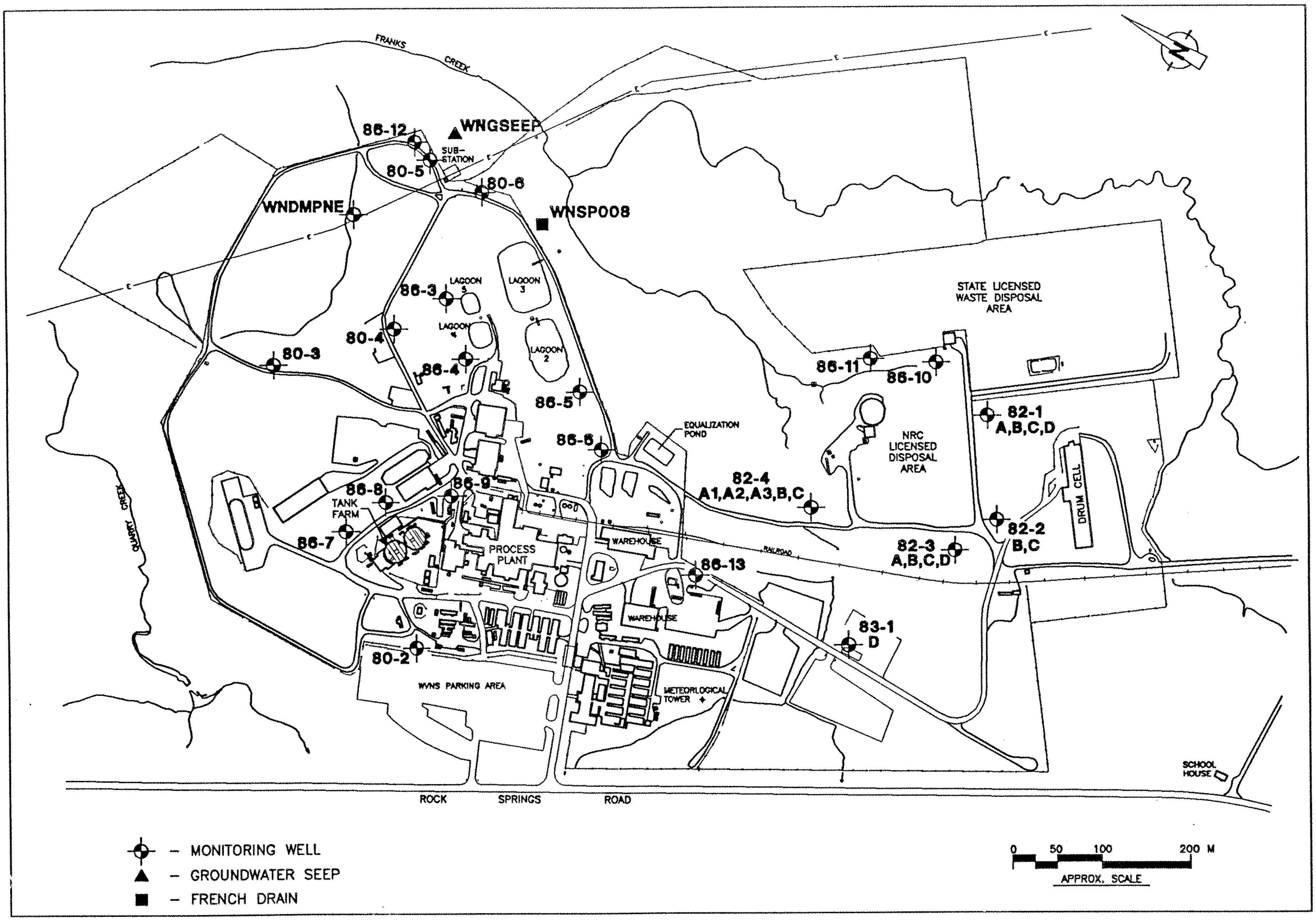


Figure 3-3. Location of On–Site Groundwater Monitoring Points.

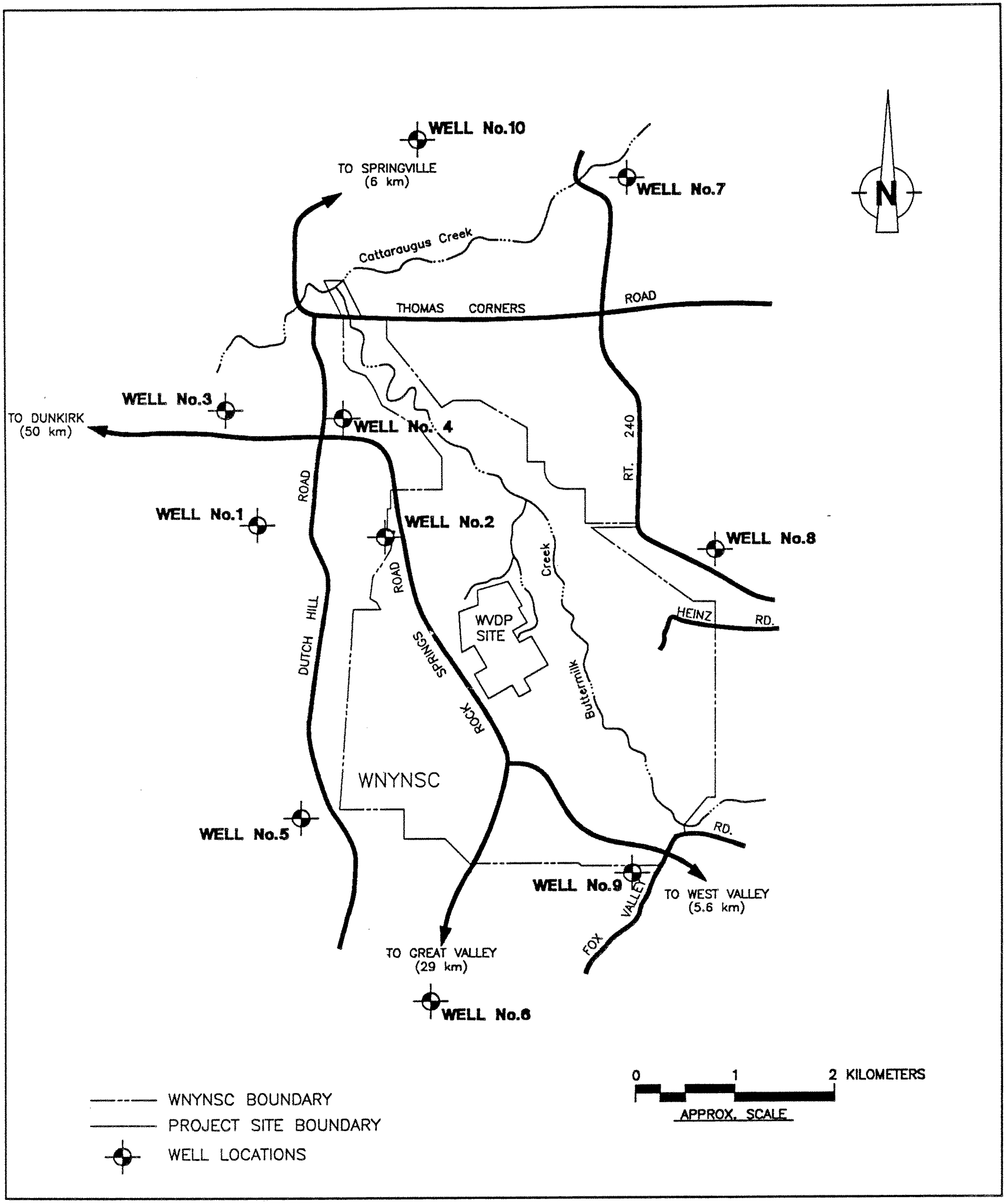


Figure 3-4. Location of Off-Site Groundwater Monitoring Points.

3. 2. 2 Waste Management Units

3.2.2.1 The Low-level Radioactive Waste Lagoon System

The low-level radioactive waste lagoon system is made up of four active lagoons, nos. 2, 3, 4, and 5, and an inactive lagoon, no.1, which has been filled. The active lagoons are currently used by the Project to treat low-level radioactive liquid waste and store treated water prior to discharge. The water is processed through the low-level waste treatment facility in batches.

Lagoons 1, 4, and 5 are constructed in the alluvial sand and gravel strata, and Lagoons 2 and 3 penetrate through these surficial deposits into the Lavery till (Bergeron et al., 1987). Both Lagoons 4 and 5 have synthetic membrane liners. The remaining lagoons are not lined with synthetic material. Mapping of groundwater elevations within this region (Bergeron et al., 1987) indicates that groundwater flows northeast and east.

A french drain was constructed around Lagoons 2 and 3 by the original operator of the reprocessing plant to minimize the amount of clean groundwater flow into Lagoons 2 and 3. The drain extends downward approximately to the top of the Lavery till and discharges on the southeast side of the road between Lagoon 3 and Erdman Brook. This french drain is also included on the site SPDES permit and is identified as location WNSP008.

Table 3-2 summarizes the locations of the wells used to monitor groundwater near the low-level radioactive lagoon system. (See also Figure 3-5).

3. 2. 2. 2 High-level Waste Tank Complex

The high-level waste tank complex includes the high-level waste tanks constructed by the former site operator and the supernatant treatment system constructed by the WVDP. The liquid high-level waste is stored in steel tanks contained in reinforced concrete vaults extending 40 feet below-grade into the Lavery till. The till – sand unit is absent beneath this complex.

The Supernatant Treatment System (STS)

The supernatant treatment system uses an ion exchange process to decontaminate liquid high-level waste. Facilities for this process are located below-grade in reinforced concrete structures and in above-grade buildings. The below-grade structures extend 20 feet below the surface and are located entirely within the alluvial sand and gravel unit.

Table 3-2

Low-Level Radioactive Waste Lagoon System Groundwater Monitoring Wells

LOCATION CODE	WELL POSITION	WELL DEPTH (ft)*	ID (in)**	COMMENTS
WNW86-06	Upgradient	14.4	4	Upgradient well for lagoon system
WNW80-05	Downgradient	16.2	2	Monitors alluvial sand and gravel
WNW80-06	Downgradient	16.9	2	Monitors alluvial sand and gravel
WNW86-03	Downgradient	26.8	4	Monitors alluvial sand and gravel
WNW86-04	Downgradient	25.1	4	Monitors alluvial sand and gravel
WNW86-05	Downgradient	14.6	4	Monitors immediate vicinity of former Lagoon 1
WNGSEEP	Downgradient	N/A	N/A	Monitors surficial deposit seepage from North Plateau
WNSP008	Downgradient	N/A	N/A	Monitors outflow from french drain

*** Well depth measured from top of outer case. See Fig. 3-5 for sample locations. ** ID: Inside diameter**

The monitoring wells for this unit are located within the alluvial sand and gravel aquifer. One well, which is upgradient of the high-level waste tank complex, provides background information. The remaining three wells are downgradient from the facility. Two other remote downgradient locations that monitor the former nonradioactive construction and demolition debris landfill, the "cold" dump, which was closed 1986, are included in the report on this unit to allow comparison with background conditions.

The Construction and Demolition Debris Landfill

The construction and demolition debris landfill (CDDL), formerly the "cold dump," was used by Nuclear Fuel Services and the West Valley Nuclear Services Co. to dispose of nonradioactive construction debris and nonputrescible, nonhazardous trash. There is no record of disposal of hazardous materials in this facility; however, there is also no evidence of waste acceptance procedures that would exclude them. The landfill was closed in 1986 with the approval of the New York State Department of Environmental Conservation. Closure consisted of covering the landfill with compacted clay till.

The CDDL is underlain by the alluvial sand and gravel unit which is 10 to 15 feet thick. Flow in this unit is toward the north. The till – sand unit is not believed to extend beneath the landfill, and the depth of the lacustrine silt and sand deposits is believed to be about one hundred feet.

Table 3-3 provides information on groundwater monitoring locations of the supernatant treatment system and the landfill discussed above. (See also Figure 3-11)

3.2.2.3 NRC-Licensed Disposal Area

The NRC-licensed disposal area (NDA) contains radioactive wastes which were generated by both Nuclear Fuel Services and the West Valley Demonstration Project. The wastes generated by NFS are contained in a horseshoe-shaped area which parallels the east, north, and west boundaries of the NDA. The wastes disposed of by the WVDP are in the parcel of land contained within the horseshoe. The Lavery till is encountered at the surface of the south plateau where the NDA is located. The alluvial sand and gravel aquifer, which blankets much of the north plateau, is not in the vicinity of the NDA.The deeper aquifer unit beneath the NDA is the lacustrine silt and sand deposit, 70 to 100 feet below the surface. This unit is at least 30 feet below the deepest known disposal in the NDA and is separated from the waste by the unweathered Lavery till. From the minimal data available regarding this unit, Bergeron (1987) hypothesized that groundwater flow in the lacustrine silt and sand deposit was toward the north – northeast.

Table 3-3

High-Level Waste Tank Complex Groundwater Monitoring Locations (including CDDL Wells)

LOCATION CODE	WELL POSITION	WELL DEPTH* (ft)	ID (in)**	COMMENTS
WNW80-02	Upgradient	16.6	2	Upgradient well for High-level Waste Tank Complex
WNW86-07	Downgradient	20.1	4	Monitors alluvial sand and gravel
WNW86-08	Downgradient	20.1	4	Monitors alluvial sand and gravel
WNW86-09	Downgradient	27.9	4	Monitors alluvial sand and gravel
WNW86-12	Downgradient	20.1	4	Monitors alluvial sand and gravel
WNDMPNE	Downgradient	7.8	8	Monitors surficial drainage near CDDL (former "Cold Dump")

*** Well depth measured from top of outer case. See Fig. 3-11 for sample locations. ** ID: Inside diameter**

The NDA was used by Nuclear Fuel Services for disposing of radioactive wastes other than the high-level liquid radioactive waste generated by reprocessing operations. The wastes included leached fuel assembly hulls and ends, sludges, resins, filter media from air and water treatment systems, spent solvents (sorbed onto solid material), discarded vessels, and piping and miscellaneous trash. It is believed that NFS also buried some damaged hardware possibly containing spent fuel in this facility.

The WVDP also disposed of wastes that had been generated by maintenance of the plant in the safe-shutdown-condition while high-level waste solidification progressed. Disposal of WVDP waste in the NDA stopped in 1986.

Hazardous and/or radioactive mixed-waste also may have been disposed of in this facility although there is no record of such disposals. At a minimum these wastes might include liquid scintillation vials, other laboratory wastes, and elemental lead used for shielding or shielded disposal containers. There are records of disposals of lead shielding by the WVDP in this facility. However, at the time of disposal this shielding, which was part of the waste disposal package, was not classified as waste by Department of Energy policy.

Groundwater monitoring locations for this solid waste management unit are located in the lacustrine silt and sand deposits. Table 3-4 describes the wells within this unit. (See also Figure 3-14).

3.2.3 On-Site Supporting Well Monitoring

In addition to the wells described above, many other wells (WNW80 and WNW82 series) are sampled on a semiannual basis primarily to update historical data. Parameters monitored on samples from these wells include gross radiological constituents, tritium, isotopic gamma emitters, pH, and conductivity. The wells were installed to obtain water level measurements and may be deleted from the sampling program as new wells, constructed specifically for groundwater sampling, are brought on line.The below-ground gasoline and diesel fuel storage area is monitored by well WNW86-13. Samples collected from this location are monitored for selected volatile organic compounds (benzene, toluene, and xylenes) which would indicate fuel leakage. Other selected water quality parameters and radioactivity are also monitored at this location.

Table 3-5 describes the wells in the supporting groundwater monitoring program.

3.3 Groundwater Monitoring Results

3.3.1 Statistical Treatment of Groundwater Data

Groundwater Contamination Indicator Data

Site-induced contamination of groundwater may be indicated when differences are observed between waste management unit wells located hydraulically upgradient and downgradient. Typically, pH, conductivity, total organic carbon, and total organic halogens are used as indicators of contamination.

Table 3-4

NRC-Licensed Disposal Area Groundwater Monitoring Locations

LOCATION CODE	WELL POSITION	WELL DEPTH (ft) *	ID (in)**	COMMENTS
WNW83-1D	Upgradient	56.0	2	Upgradient well for NRC-Licensed Disposal Area
WNW82-1D	Downgradient	99.9	2	Monitors lacustrine silt and sand - Dry Well
WNW86-10	Downgradient	117.0	2	Monitors lacustrine silt and sand
WNW86-11	Downgradient	117.0	2	Monitors lacustrine silt and sand

*** Well depth measured from top of outer case. See Fig. 3-14 for sample locations. **ID: Inside diameter**

Table 3- 5

Supporting Groundwater Monitoring Locations

LOCATION CODE	WELL DEPTH (ft)*	ID (in)**	COMMENTS
WNW80-03	8.0	2	Monitors alluvial sand and gravel of North Plateau
WNW80-04	12.8	2	Monitors alluvial sand and gravel of North Plateau
WNW82-1A	20.3	1	Monitors Lavery Till of South Plateau
WNW82-1B	31.0	1	Monitors Lavery Till of South Plateau
WNW82-1C	52.8	1	Monitors Lavery Till of South Plateau
WNW82-2B	41.0	1	Monitors Lavery Till of South Plateau
WNW82-2C	52.1	1	Monitors Lavery Till of South Plateau
WNW82-3A	20.5	1	Monitors Lavery Till of South Plateau
WNW82-4A1	16.5	0.7	Monitors Lavery Till of South Plateau
WNW82-4A2	17.0	0.7	Monitors Lavery Till of South Plateau
WNW82-4A3	18.2	0.7	Monitors Lavery Till of South Plateau
WNW86-13	11.9	4	Monitors petroleum fuel storage area

*** Well depth measured from top of outer case. ** ID: Inside diameter**

At the West Valley Demonstration Project, radiological site-specific parameters are included in the groundwater indicators list shown in Table 3-1. The radiological measurements are most likely to be the more sensitive of the indicator parameters listed. Tritium, being an integral part of the water molecule itself, serves as a very early and sensitive contamination indicator.

Eight independent samples were collected for each of the indicator parameters from each well in the waste management unit monitoring program. These indicator data were treated with the Analysis of Variance statistical technique (ANOVA). The ANOVA method compares mean concentrations of a given parameter for samples collected at different monitoring locations. This comparison determines if statistically significant differences exist between well data within the same waste management unit. If significant differences are determined, statistical contrast procedures are used to evaluate which location(s) are different.

Any differences indicated by the ANOVA method may reflect either positive or negative differences with respect to the upgradient well location. Negative differences are cause for concern only with the pH indicator parameter. Negative differences for the other indicator parameters (lower concentrations at downgradient locations compared to upgradient locations) are not considered indicators of contamination.

The ANOVA is a recommended statistical method for evaluating statistical differences between upgradient and downgradient groundwater data (USEPA, 1989). It is important to note, however, that significant differences do not imply a rising or falling trend within a given well, but rather that the well has a significantly different concentration than the upgradient well.

Tabular Presentation of Results

Appendix E provides tables of all data collected for the routine groundwater monitoring program during 1989. All waste management unit groundwater data were obtained from the collection of four independent samples in each semiannual period.

Table 3-6

Summary of Groundwater Monitoring Data for the Low-Level Radioactive Lagoon System Unit

STATISTICAL DIFFERENCES OBSERVED AT DOWNGRADIENT WELLS COMPARED TO UPGRADIENT WELL WNW86-6

Parameter	WNGSEEP	WNSP008	WNW80-05	WNW80-06	WNW86-03	WNW86-04	WNW86-05
pH	lower	-	-	lower	higher	higher	-
Conductivity	-	-	-	-	-	-	-
TOC	-	-	-	-	-	-	higher
TOX	-	-	-	-	-	-	-
Tritium	higher	higher	higher	higher	higher	higher	higher
Gross Alpha	-	-	-	-	-	-	higher
Gross Beta	-	higher	-	-	-	higher	higher
Nitrate-N	higher	higher	higher	-	higher	higher	-

Note: For pH, "lower" indicates results lower than the upgradient well. For all parameters, "higher" indicates results higher than the upgradient well.

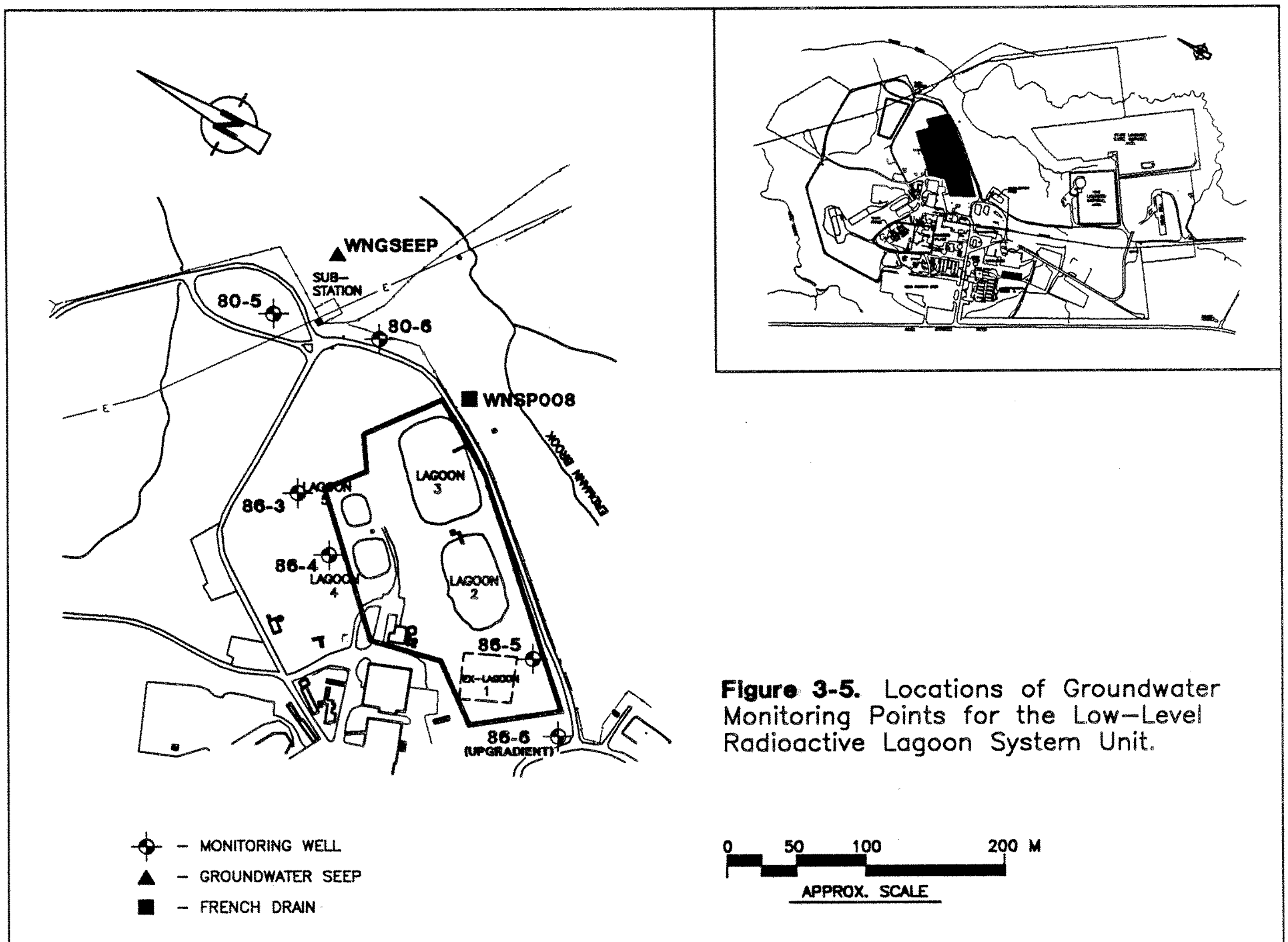


Figure 3-5. Locations of Groundwater Monitoring Points for the Low-Level Radioactive Lagoon System Unit.

3.3.2 Low-level Radioactive Waste Lagoon System

Table 3-6 summarizes the statistically significant differences observed between upgradient and downgradient wells within the low-level radioactive waste lagoon system for the groundwater contamination indicator parameters as described above in Section 3.3.1. (See Figure 3-5 for locations of wells within this unit).

Several items within Table 3-6 are noteworthy. Tritium concentrations at all downgradient locations are significantly greater than at upgradient well WNW86-06. Also, gross beta activity compared to upgradient concentrations was shown to be significantly elevated at several locations The areal extent of gross beta contamination, however, is more limited when compared to the areal extent for tritium.

Both cesium-137 and cobalt-60 are potential site contaminants because they are part of the nuclear fuel cycle. These isotopes are found in the liquid high-level waste in substantial amounts. Neither cesium-137 nor cobalt-60, both gamma-emitting radionuclides, were detected in any of the groundwater samples collected from any of the routinely monitored groundwater locations.

Table 3-6 also indicates that several chemical indicator parameters (pH, nitrate, and total organic carbon) are significantly different at downgradient monitoring locations.

Figure 3- 6

Averaged 1989 Tritium Concentrations (μCi/mL) for Wells Monitoring the Low-Level Radioactive Lagoon System Unit. (Note log scale).

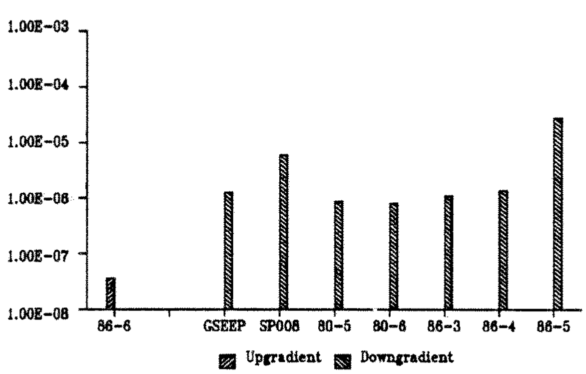
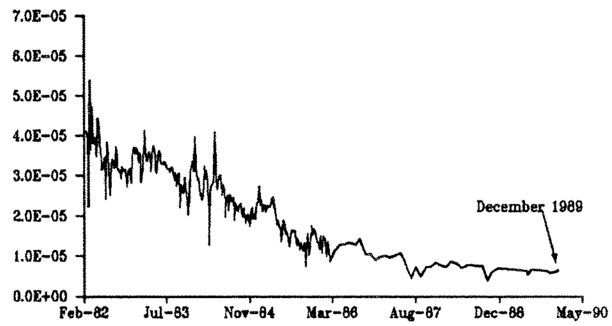


Figure 3 - 7

Tritium Concentrations (μCi/mL)1982 - 1989 at the Low-level Radioactive Lagoon System Unit. Monitoring point is WNSP008.



Analysis of contamination indicator data suggests that groundwater contamination has occurred around the immediate vicinity of the low-level radioactive waste lagoon system. These findings are, however, consistent with past evaluations (WVNS, 1988; Marchetti, 1982) which have indicated levels of radioactivity in groundwater above natural background levels. Figure 3-6 shows in graphic form a comparison of averaged tritium concentrations measured during 1989 for all wells within the low-level radioactive waste lagoon system. As the figure indicates, there are obvious differences between groundwater monitoring locations. (Note that the Y-axis in Figure 3-6 is presented with a logarithmic scale). In addition to Figure 3-6, Figure 3-7 provides results for long-term measurements of tritium made at one location, the french drain (WNSP008). This line graph indicates that tritium concentrations have decreased substantially since 1982. However, concentrations are still elevated compared to background.

Figure 3-8 is a bar graph of averaged gross beta activity for wells within the low-level radioactive waste lagoon system monitoring unit. As with the tritium bar graph, the Y-axis is presented on a logarithmic scale. The locations which show the most elevated tritium concentrations also show the most elevated gross beta concentrations. In both cases, locations WNW86-05 and WNSP008 are more greatly elevated than the remaining downgradient locations.

Figure 3- 8

Averaged 1989 Gross Beta Concentration (µCi/mL) for Wells Monitoring the Low-Level Radioactive Lagoon System. (Note log scale).

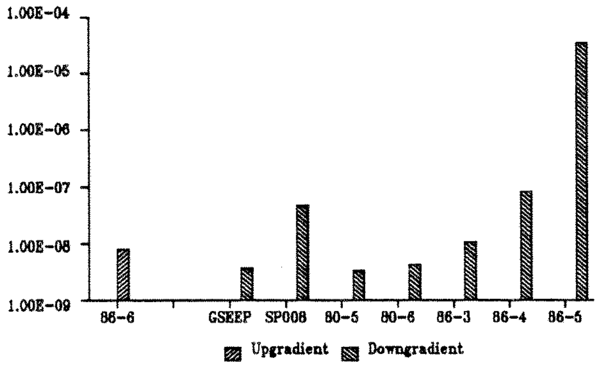
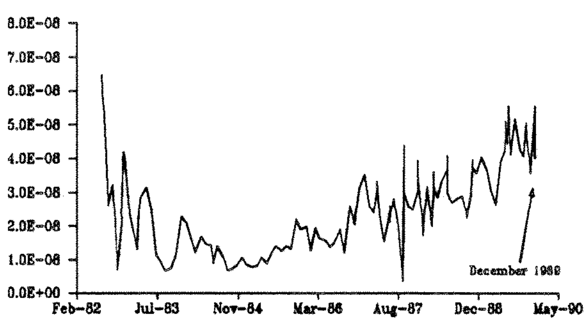


Figure 3-9 shows the results of long-term measurements of gross beta activity made at the french drain (WNSP008). These data do not show the same declining trend as noted for the tritium data collected from this location.

Well WNW86-05 shows the highest levels of tritium and gross beta activity for any of the wells routinely monitored on-site. Well WNW86-05 is located at the downgradient edge of former Lagoon 1 (See Figure 3-5). Figure 3-10 shows the complete history of tritium and gross beta monitoring since the initial sampling of this well in December 1986. As indicated, tritium concentrations have remained relatively constant over the period that this well has been monitored. Concentrations of gross beta activity also appear relatively constant; however, the data tend to suggest a slight upward trend over time.

Figure 3-9.

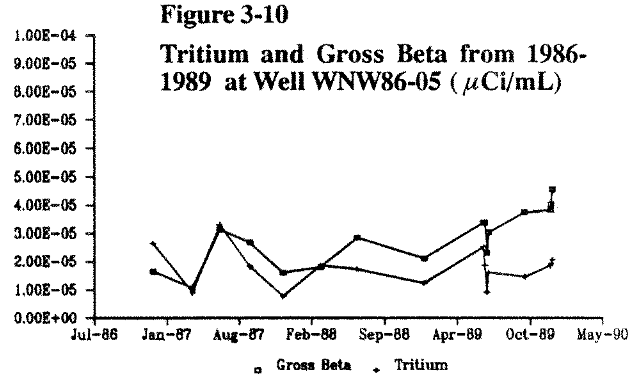
Gross Beta Concentrations(µCi/mL) from 1982-1989 at the Low-Level Radioactive Lagoon Monitoring Point WNSP008



Well WNW86-05 is currently the only routinely monitored waste management unit well which exceeds the DOE's DCG limit for radioactivity. Gross beta levels (3.5E-05 µCi/L) exceed upgradient background concentrations (gross beta = 8.0E-09 µCi/mL at upgradient well WNW86-06) by about 4,500-fold. The Sr-90 DCG limit (1.0E-06 µCi/mL) is exceeded by approximately 35-fold. The Sr-90 DCG limit is used for comparison to gross beta concentrations because it is most likely to be the site's beta contaminant. Note that tritium concentrations are elevated by about 175-fold when compared to upgradient background. However, the tritium concentrations at this location are still well below the DCG level of 2E-03 µCi/mL.

Figure 3-10

Tritium and Gross Beta from 1986-1989 at Well WNW86-05 (µCi/mL)



3.3.3 High-level Radioactive Waste Tank Complex

Table 3-7 is the statistical summary table for contamination indicator parameters for the high-level waste tank complex and former cold dump. Although the CDDL is not part of the high-level waste tank complex it is included in the table for comparison to background conditions at upgradient well WNW80-02. (See Figure 3-11, which shows the locations of these groundwater monitoring locations).

For the wells monitoring the high-level waste area, only well WNW86-09 shows significantly elevated levels of tritium when compared to site upgradient well WNW80-02. In past years, well WNW86-08 has also shown elevated levels of tritium; however, during 1989 tritium levels declined at this location. Four out of the eight samples collected at this loca-

Table 3- 7

Summary of Groundwater Monitoring Data for the High-Level Radioactive Waste Tank Complex and Cold Dump

STATISTICAL DIFFERENCES OBSERVED AT DOWNGRADIENT WELLS COMPARED TO UPGRADIENT WELL WNW80-02

Parameter	WNW86-7	WNW86-8	WNW86-9	WNW86-12*	WNDMPNE*
pH	lower	lower	lower	-	lower
Conductivity	higher	higher	higher	higher	higher
TOC	-	higher	higher	-	higher
TOX	-	-	-	-	-
Tritium	-	-	higher	higher	-
Gross Alpha	-	-	-	-	-
Gross Beta	higher	higher	higher	-	higher
Nitrate-N	higher	-	higher	-	-

Note: For pH, "lower" indicates decrease. For all parameters, "higher" indicates increase.

*** Monitoring wells near former Cold Dump.**

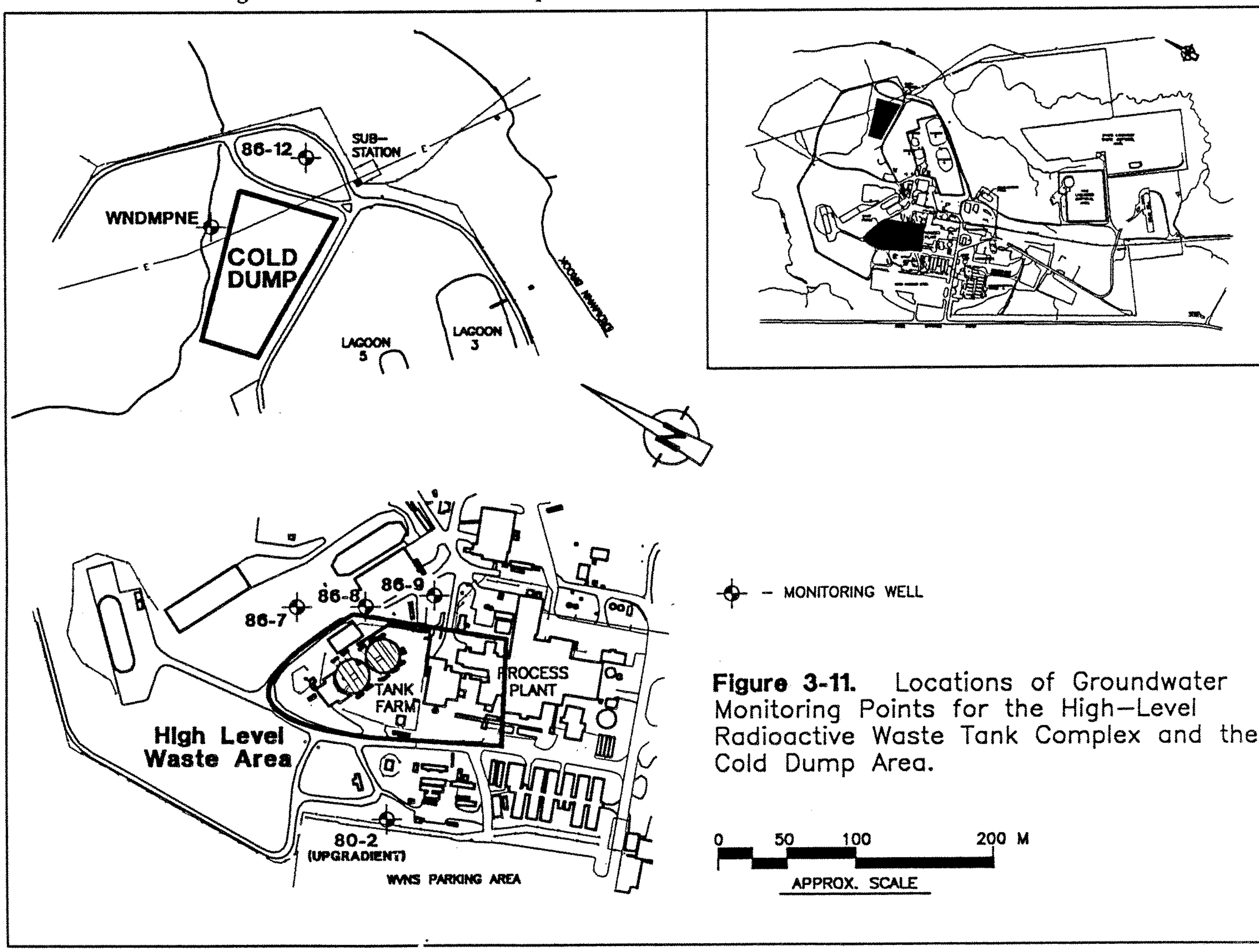
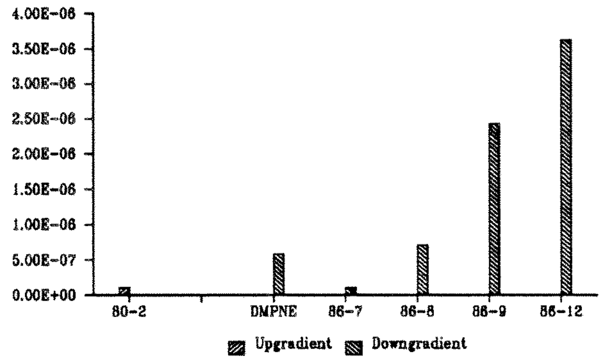


Figure 3-11. Locations of Groundwater Monitoring Points for the High-Level Radioactive Waste Tank Complex and the Cold Dump Area.

Figure 3-12.

Averaged 1989 Tritium Concentrations (μCi/mL) for Wells Monitoring the High-Level Radioactive Waste Tank Complex and CDDL.



tion were less than the detection limit of 1E-7 μCi/mL for tritium. Elevated levels of gross beta activity continue to be more widespread, as indicated in Table 3-7.

For the two locations monitoring the CDDL (WNW86-12 and WNDMPNE), tritium was elevated at well WNW86-12, and gross beta was elevated at location WNDMPNE. These observations are consistent with past findings for 1987 through 1988 (WVNS, 1988).

Figures 3-12 and 3-13 are bar graphs illustrating the averaged concentrations of tritium and gross beta for wells monitoring the high-level waste tank complex and CDDL. These figures provide visual comparisons of concentrations for these important groundwater monitoring parameters. The radiological data suggest that although differences exist between upgradient and downgradient locations, the differences do not reflect leakage from the tanks containing the high-level radioactive waste. The observed differences noted are similar to past findings and may be attributable to soil and water contamination from past operations of the facility. Further, monitoring in the immediate vicinity of the high-level waste tanks continues to validate their integrity. Table 3-7 also shows that for the wells that monitor these two waste management units, significant differences between upgradient and downgradient locations were observed for chemical contamination indicator parameters. The pH and conductivity results indicate lower levels of pH for all wells except WNW86-12, and higher levels of conductivity for all downgradient wells. It is not known if these changes are directly attributable to activities at the site, but these observations are consistent with past findings in this area (WVNS, 1988).

3. 3. 4 NRC-Licensed Disposal Area Monitoring Unit

Table 3-8 presents summary statistics for the contamination indicator parameters monitored in the NRC- licensed disposal area. As the table indicates, only minor differences between upgradient and downgradient locations were observed. The fact that tritium concentrations at these three locations are at background levels and show no significant differences between locations provides reassuring evidence that groundwater contamination has not occurred in the lacustrine silt and sand deposits. These conclusions are consistent with past observations in this area. Figure 3-14 shows the locations of wells monitoring this unit.

Although lacustrine deposit contamination is not suspected, the NDA area is currently undergoing significant remediation. In 1983 the migration of radiologically contaminated organic solvent was observed in the weathered Lavery till in relatively shallow wells (82-series) that monitored the northeast sector of the NDA area. Efforts continue to remediate and check the migration of organic and radiological contamination from this area into adjacent surface waters. Section 2.6 of this report

Figure 3-13.

Averaged 1989 Gross Beta Concentrations (μCi/mL) for Wells Monitoring the High-Level Radioactive Waste Tank Complex and CDDL.

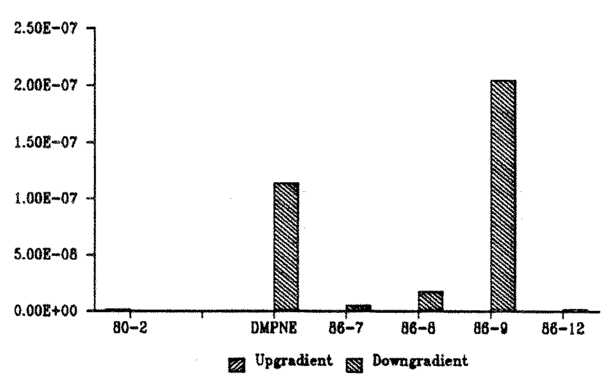


Table 3-8

Summary of Groundwater Monitoring Data for the NRC-Licensed Disposal Area

STATISTICAL DIFFERENCES OBSERVED AT DOWNGRADIENT WELLS COMPARED TO UPGRADIENT WELL WNW83-1D

Parameter	WNW86-10	WNW86-11	WNW82-1D
pH	higher	-	dry
Conductivity	higher	higher	dry
TOC	-	-	dry
TOX	-	-	dry
Tritium	-	-	dry
Gross Alpha	-	-	dry
Gross Beta	higher	-	dry
Nitrate-N	-	-	dry

For ph,"lower" indicates decrease. For all parameters,"higher" indicates increase.

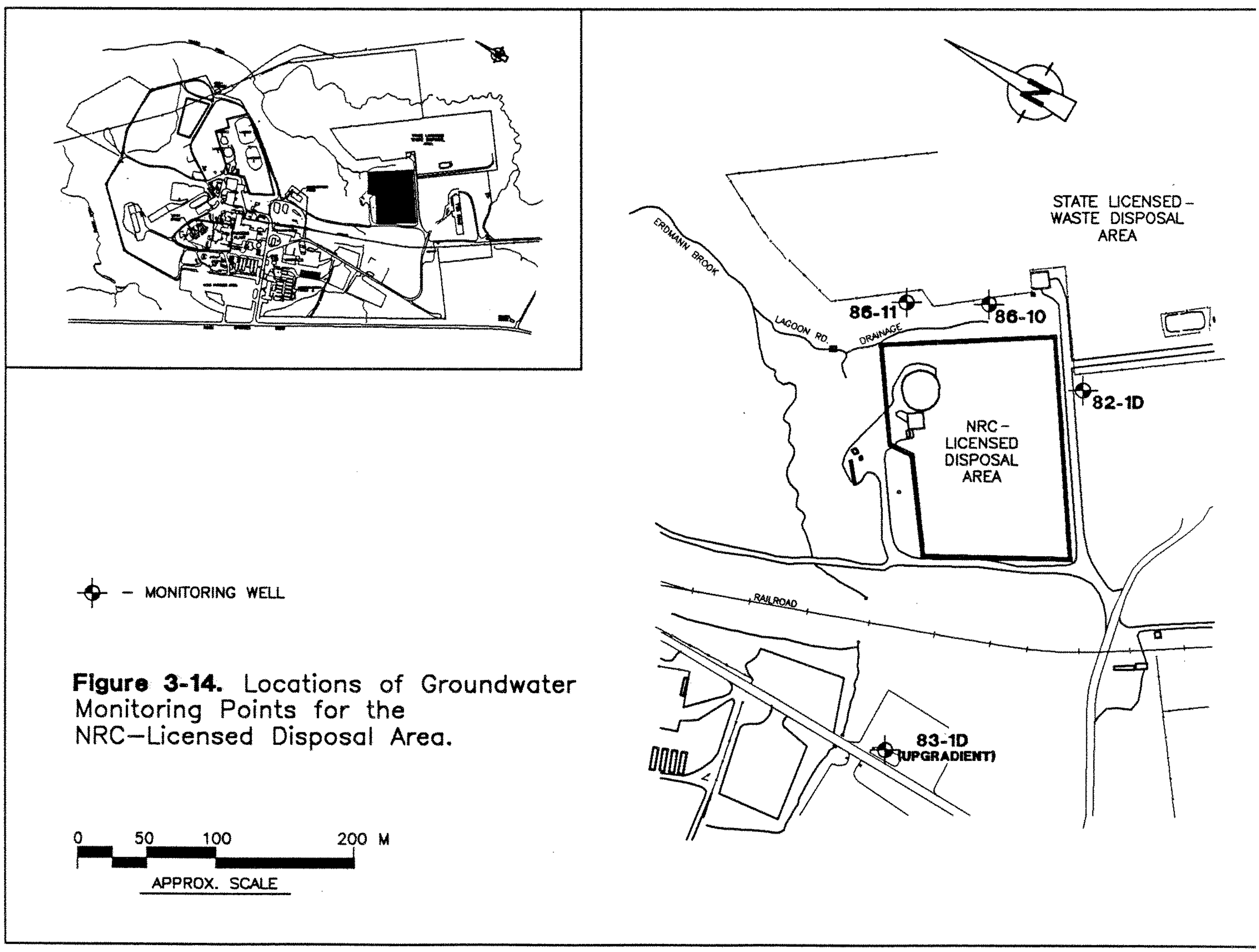


Figure 3-14. Locations of Groundwater Monitoring Points for the NRC-Licensed Disposal Area.

describes some special sampling, carried out during December of 1989 in the immediate vicinity of the organic migration area, that focused on shallow wells within the weathered Lavery till.

3.3.5 Significance of Waste Management Unit Monitoring

The above discussions address specific groundwater monitoring carried out during 1989 around waste management units. Statistical comparisons between upgradient and downgradient wells help determine whether groundwater contamination has occurred around the monitored units.

Sufficient evidence exists to suggest that groundwater surrounding the low-level radioactive waste lagoon system, the high-level radioactive waste tank complex, and the CDDL has been affected by operations at the site.

Within the low-level radioactive waste lagoon system the greatest impacts have been observed nearest the actual lagoons. This is indicated by Figures 3-6 and 3-8 which show the highest levels of contamination at the downgradient edge of former Lagoon 1 (well WNW86-05) and at the french drain (WNSP008). The long term trends for radiological activity at WNSP008 indicate that tritium activity (Figure 3-7) has declined substantially during the past eight years. It was noted, however, that gross beta activity (Figure 3-8) has not shown this decreasing trend. Figure 3-10 presents trend data for tritium and gross beta activity at well WNW86-05. This plot indicates that tritium concentrations have remained relatively stable and that gross beta levels are relatively stable or increasing slightly with time.

Results for the high-level radioactive waste tank complex indicate that groundwater quality within this unit has been affected by site activities. However, because of the levels and nature of the contamination, these effects appear unrelated to the actual storage of the liquid high-level waste. It is likely that the radiological and chemical differences noted between upgradient and downgradient locations are the result of previous operations of the reprocessing facility and possible subsurface changes influenced by construction activity.

Groundwater monitoring results for the NRC–licensed disposal area do not suggest any real impacts to the lacustrine silt and sand deposits. This conclusion is based upon the lack of significant differences between upgradient and downgradient locations, most notably with respect to tritium. It must be added, however, that continued remediation occurs within the actual disposal unit to control the migration of radiologically contaminated organic solvent within the Lavery till.

3.3.6 Other Supporting Wells Monitored On-Site

Supporting wells monitored on the site include those wells which are not part of the waste management unit monitoring program. These wells, which are monitored semiannually, were installed primarily to measure groundwater elevations and may be phased out of service as new groundwater monitoring wells are brought on-line. Data resulting from sample collection (shown in Appendix E, Table E-1) are generally consistent with past observations from these wells. The continued detection of elevated levels of tritium in well WNW82-4A1 appears to be of greatest significance. Tritium concentrations in this well are approximately 400-fold greater than in adjacent wells WNW82-4A2 and WNW82-4A3. All three wells are located in a straight line at approximately the same depth and are separated by about 19 feet (See Table 3-5). It was observed during installation of well WNW82-4A1 that the well boring was drilled into a filled excavation created by NFS to make a ramp to dispose of a large dissolver into Special Hole (SH) 9 in the then-active NRC-licensed disposal area. Wells WNW82-4A2 and WNW82-4A3 were installed after well WNW82-4A1. Tritium concentrations from these latter two wells are substantially lower than values observed in well WNW82-4A1. It is believed that groundwater flow from this previously excavated area is not of sufficient volume to affect surface water; however, additional wells have been located downgradient of this area to provide additional monitoring.

Of additional significance is the continued detection of gross beta concentrations in the low E-07 μCi/mL range at well WNW80-03, levels that have been observed at this location for several years. The cause for the elevated levels in this shallow well is not fully understood. The well is downgradient of a former contaminated hardstand area and also downgradient of the main plant facilities. The fact that tritium concentrations at this location are low suggests that the detected beta activity may stem from localized surface soil contamination, mobilized by surface water flow.

In addition to the routine sampling of the above supporting wells, all active site wells and several older wells were sampled for the presence of volatile organic compounds during 1989. This special sampling was undertaken because of a continuing increased awareness of the proper management of chemical constituents as well as radiological materials. Analysis of these samples included full GC/MS analysis for either the hazardous substance list or RCRA Appendix IX of 40 CFR Part 264 list of volatile organic compounds.

The results of sampling for volatile compounds revealed that three wells contained 1,1-dichloroethane at levels greater than the analytical detection limit of 5 μg/L (ppb). Wells WNW86-09, WNWN-1 (both near the high-level radioactive waste tank complex), and well WNW86-12 (near the CDDL) exhibited concentrations ranging between 6.5 and 18.5 μg/L. These values marginally exceed the New York State groundwater quality standards for class GA waters. (See section 3.3.8 below).

At this time there appears to be no direct hydraulic connection between the 1,1-dichloroethane detected in the two separate locations. In addition, the lack of positive results above the analytical detection limit for all of the other wells sampled suggests that this contamination is not widespread through the site. Upon completion of follow-up confirmatory sampling in 1989, the WVDP notified the New York State Department of Environmental Conservation about the findings relative to 1,1-dichloroethane. The origin of this compound is not yet understood. The expansion of the Project's groundwater monitoring program during 1990 may help identify the nature of the distribution of this compound.

3.3.7 Groundwater Monitoring at the Below-Grade Fuel Storage Area

Table E-2 in Appendix E records the results of groundwater monitoring at well WNW86-13 located near the below-grade gasoline and diesel fuel storage area. These results do not indicate any adverse effects on the groundwater.

3.3.8 Data Comparison to New York State Groundwater Quality Standards

Table 3-1 presents the New York State Groundwater Quality Standards for Class GA waters for the parameters measured by the WVDP groundwater monitoring program. These standards are derived from Title 6 of the New York Code of Rules and Regulations (NYCRR), Chapter X, Part 703.5. Water meeting these standards is acceptable for use as a potable water supply. These standards provide a conservative reference for comparison to site groundwater as site groundwaters are not used to supply on- or off-site potable water. In addition to Table 3-1, the quality standard concentrations are listed at the top of each data column, according to respective parameter, in Tables E-3 through E-14 in Appendix E.

Comparing 1989 site groundwater data to these quality standards reveals the following noteworthy items. For the radiological parameters monitored, both tritium and gross beta concentrations at well WNW86-05 exceeded the respective quality standard. This location, discussed above in Section 3.3.2, is at the immediate downgradient edge of former Lagoon 1. No other radiological parameters measured for waste management unit wells exceeded the appropriate groundwater quality standards. Future comparisons are planned for the beta emitter Sr-90 which has a quality standard lower than that for gross beta activity. Several wells on-site may be above the Sr-90 quality standard but still be below the gross beta quality standard. Note that only well WNW86-05 exceeds the DCG limit of 1.0E-06 μCi/mL for Sr-90 (as indicated by gross beta measurements). Results for pH were marginally lower than the range of 6.5 - 8.5 at groundwater locations WNW86-07, WNW80-06, and WNGSEEP.

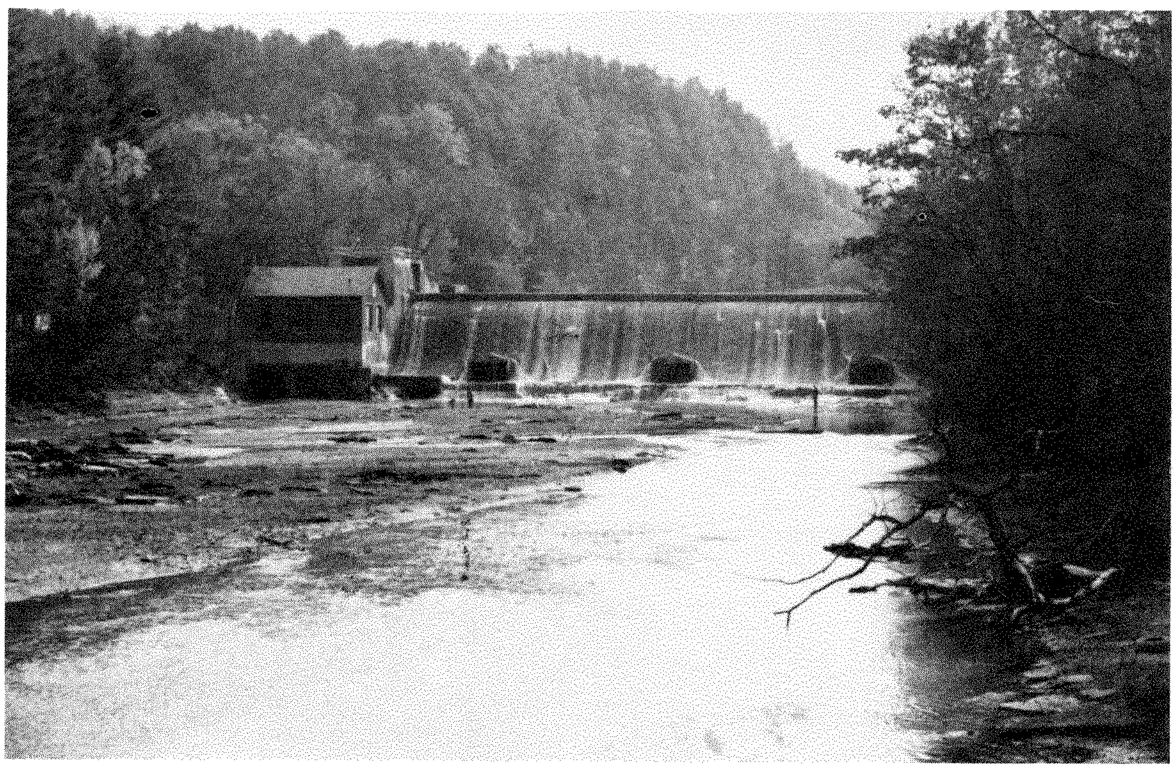
Results for sodium and chloride exceeded the quality standard at well WNW86-06 by a significant margin. This is thought to be attributable to operation of the nonradiological sludge ponds.

The above instances in which groundwater quality exceeded standards are believed due, in part, to past and/or present activities at the site. In all cases, the reported concentrations are also significantly different from background concentrations.

Other instances in which groundwater quality standards were exceeded were observed at other locations. However, these are not believed to be directly attributable to site activities. They included elevated levels of some metals, which are believed to be naturally occurring(sodium, iron, and manganese), in both upgradient and downgradient wells. Elevated levels of some other metals (lead, chromium, and cadmium) were observed in unfiltered samples only. Samples filtered and collected at the same time did not confirm the presence of these metals. The cases in which total metals exceeded standards are attributed primarily to the incorporation of sediments and well fines into the unfiltered samples. One well location, WNW86-10, exceeded the pH range of 6.5 - 8.5 on two out of eight measurements. These high pH levels are believed to be due to natural levels and/or technical difficulties in sampling deep, low-yield wells. Finally, although mercury and phenol concentrations have been observed at levels above the groundwater quality standards, analytical results for those samples are in question. For example, two total mercury analyses exceeded the quality standard out of a total of 270 measurements taken. Follow-up sampling and analysis did not indicate any detectable mercury concentrations above the standard, providing further indication that these positive data may not be valid.

3. 3. 9 Off-Site Groundwater Monitoring

During 1989 all of the off-site groundwater residential wells were sampled for radiological contamination, pH, and conductivity. These wells are used by site neighbors as sources of drinking water. There continues to be no evidence indicating contamination of these off-site water supplies by the WVDP. Results for these samples are found in Table C-1.8 in Appendix C.



CATTARAUGUS CREEK AT SPRINGVILLE DAM DOWNSTREAM OF THE WVDP

4.0 Radiological Dose Assessment

4.1 Introduction

Each year the potential radiological dose to the public is assessed in order to ensure that no individual could possibly have received an exposure which exceeded the limits established by the cognizant regulatory agencies. The results of these conservative calculations demonstrate that the hypothetical maximum dose to an off-site resident is well below permissible standards and is consistent with effective applications of the "as low as reasonably achievable" (ALARA) philosophy of radiation protection.

Dose Estimates

This chapter describes the methods used to estimate the dose to the public from radionuclides emitted from the West Valley Demonstration Project through air and water discharges during 1989. The dose estimates are based on concentrations of radionuclides measured in air, water, and in food samples collected both on– and off–site throughout 1989. These estimates are compared to the radiation standards established by the Department of Energy and the Environmental Protection Agency for protection of the public. The radiation doses reported for 1989 are also compared to the doses reported in previous years.

Computer Modeling

Because of the difficulty of measuring the small amounts of radionuclides emitted from the site beyond those that occur naturally in the environment, computer models were used to calculate the environmental dispersion of the radionuclides emitted from monitored ventilation stacks and liquid discharge points on the site. These models have been approved by the Department of Energy and the Environmental Protection Agency to demonstrate compliance with radiation standards. Radiological dose is evaluated for the three major exposure pathways: external irradiation, inhalation, and ingestion of local food products. The dose contributions from each radionuclide and pathway combination are then summed to obtain the reported dose estimates.

In addition to the computer estimates, concentrations of radionuclides in air and food samples collected near the site are compared to background concentrations. In those samples where radionuclides were determined to be in excess of background concentrations, the excess was attributed to Project releases. In such cases, estimates were made of the maximum radiation dose that could be incurred by a nearby resident.

4.1.1 Sources of Radiation Energy and Radiation Exposure

Radionuclides

Atoms that emit radiation are called radionuclides. Radionuclides are variations – isotopes – of elements: They have the same number of protons and electrons but different numbers of neutrons, resulting in different atomic masses. For example, the element hydrogen has two stable isotopes, H-1 and H-2 (deuterium), and one radioactive isotope, H-3 (tritium). (The numbers following the element's symbol identify the atomic mass, the numbers of protons and neutrons, in the nucleus).

Once a radioactive atom decays by emitting radiation, the resulting daughter atom may itself be radioactive or stable. Each radioactive isotope has a unique half-life which represents the time it takes for 50% of the atoms to decay. Strontium-90 and cesium-137 have half-lives of about 30 years, while plutonium-239 has a 24,000 year half-life.

Radiation Dose

The energy released from a radionuclide is eventually deposited in matter encountered along the path of radiation, resulting in a radiation dose to the absorbing material. The absorbing material can be either inanimate matter or living tissue.

While most of the radiation dose affecting the general public is background radiation, manmade sources of radiation may also contribute to the radiation dose of individual members of the public. Such sources include diagnostic and therapeutic x-rays, nuclear medicine, consumer products such as smoke detectors and cigarettes, fallout from atmospheric nuclear weapons tests, and effluents from nuclear fuel cycle facilities.

The West Valley Demonstration Project is part of the nuclear fuel cycle. The radionuclides present at the site are left over from the recycling of commercial nuclear fuel during the 1960s and early 1970s. A very small fraction of these radionuclides are released off-site annually through ventilation systems and liquid discharges. An even smaller fraction actually contributes to the radiation dose to the surrounding population.

4.1.2 Health Effects of Low Levels of Radiation

The concept of dose equivalent (DE) was developed by the radiation protection community to allow a rough comparison of doses from different types of radiation.

Effects of Radiation on Body Organs

The primary effect of low levels of radiation in an exposed individual appears to be an increased risk of cancer. Radionuclides entering the body through air, water, or food are usually distributed unevenly in different organs of the body. For example, isotopes of iodine concentrate in the thyroid gland. Strontium, plutonium, and americium isotopes concentrate in the skeleton. Uranium and plutonium isotopes, when inhaled, remain in the lungs for a long time. Some radionuclides such as tritium, carbon-14, or cesium-137, will be distributed uniformly throughout the body. Depending on the radionuclide, some organs may receive quite different doses. Moreover, another complicating factor is that at the same dose levels certain organs (such as the breast) are more prone to developing a fatal cancer than other organs (such as the thyroid).

Estimating Dose Methodology

The International Commission on Radiological Protection (ICRP) found a way to account for this difference in radionuclide distribution and organ sensitivity. In Publications 26 (1977) and 30 (1979), the Commission developed an organ-weighted-average dose methodology to limit permissible worker exposures following intakes of radionuclides. This weighting factor – a ratio of the risk from a dose to a specific organ or tissue to the total risk when the whole body is uniformly irradiated – represents the relative sensitivity of a particular organ to develop a fatal effect. For example, to determine the weighting factor following a uniform irradiation, the risk factor of death from cancer of a specific organ is divided by the total risk of dying from cancer of any organ.

Units of Measurement

The unit of dose equivalent measurement(DE) is the rem. The international unit of measurement of DE (and of the effective dose equivalent, EDE) is the sievert (Sv), which is equal to 100 rem. The millisievert (mSv), one thousand times lower, is used more frequently to report the low DEs encountered in environmental exposures. To obtain the *effective dose equivalent*, which is an estimate of the total risk from radiation exposure, the organ doses (dose equivalents) are multiplied by the respective weighting factor. These weighted DEs are then summed to obtain the effective dose equivalent (EDE).

The National Council on Radiation Protection and Measurements (NCRP) Report 93 (1987) estimates that the average annual effective dose equivalent received by a person living in the U.S. is about 360 mrem (3.6 mSv) from both natural and manmade sources of radiation (See Figure 4-1). This number is based on the collective EDE, defined as the total EDE received by a population (expressed in units of person-Sv or person-rem). The average individual EDE is obtained by dividing the collective EDE by the population number.

Risk Estimates

The Committee on Biological Effects of Ionizing Radiations (BEIR) has estimated that the increased risk of dying from cancer from a single acute dose of 10 rem (0.1 Sv) is about 0.8% of the background risk of cancer. According to the Committee, chronic exposure, i.e., accumulation of the same dose over long periods of time, might, compared to acute exposure, reduce the risk by a factor of two or more. The death rate from cancer from all causes in the United States is currently about one in eight.

The BEIR Committee has stressed that the health effects of very low levels of radiation are not clear, and any use of risk estimates at these levels is subject to great uncertainty (BEIR, 1990). As will be shown in the following sections, the estimated maximum effective dose equivalent received by a member of the public from Project activities during 1989 is many orders of magnitude lower than the exposures considered in the BEIR report.

4.2 Estimated Radiological Dose from Airborne Effluents

Sources of Radioactivity from the WVDP

As reported in Chapter 2, "Effluent and Environmental Monitoring," five stacks and vents were monitored for radioactive air emissions during 1989. The activity that was released to the atmosphere from these stacks and vents is listed in Tables C-2.1 through C-2.11 in Appendix C-2. The main plant stack, which vents to the atmosphere at a height of 60 meters (197 ft), is considered an elevated release; all other releases are considered ground level (10 m) releases. Wind data collected from the on-site meteorological tower during 1989 were used as input to the dose assessment codes. Data collected at the 60 meter and 10 meter heights were used in combination with elevated and ground level effluent release data respectively. (See Figures 4-2 and 4-3).

Airborne emissions of radionuclides are regulated by the EPA under the Clean Air Act. Department of Energy facilities are subject to 40 CFR 61, subpart H, "National Emission Standards for Hazardous Air Pollutants (NESHAP) - Radionuclides." The applicable standard for radionuclides released during 1989 is 25 mrem (0.25 mSv) and 75 mrem (0.75 mSv) to the whole body and any organ, respectively, for any member of the public.

The Clean Air Act Code (CAAC) is the approved version of the AIRDOS-EPA computer code used to demonstrate compliance with the standard for the 1989 assessment period. Using site-specific meteorological data, AIRDOS-EPA (Moore et al., 1979) calculates the dispersion of radionuclides into the environment following airborne releases and then estimates the external dose to individuals from radionuclides both in the air and deposited on the ground. It also estimates the doses to individuals from inhalation of contaminated air and ingestion of contaminated water and foods produced near the site. The mainframe computer versions of AIRDOS-EPA can also be used to estimate the collective dose to the population residing within 80 km of the site.

4.2.1 Maximum Dose to an Off-Site Resident

Based on the airborne radioactivity released from the site during 1989, and using the CAAC, a person living in the vicinity of the WVDP was estimated to receive a whole body dose equivalent of 0.0046 mrem (0.000046 mSv). This maximally exposed individual was assumed to reside continuously about 1.9 km north-northwest from the site, eating locally produced foods at the maximum consumption rates for an adult. Almost 98% of the dose was contributed by iodine-129, primarily from ingestion; the remaining radionuclides contributed less than 1% each to the total dose.

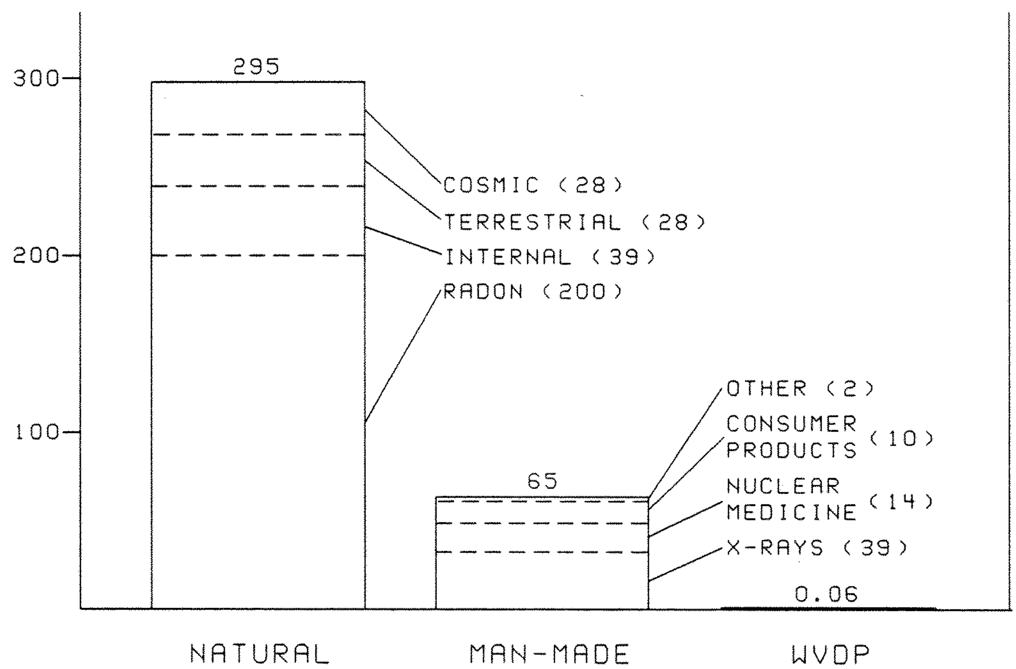
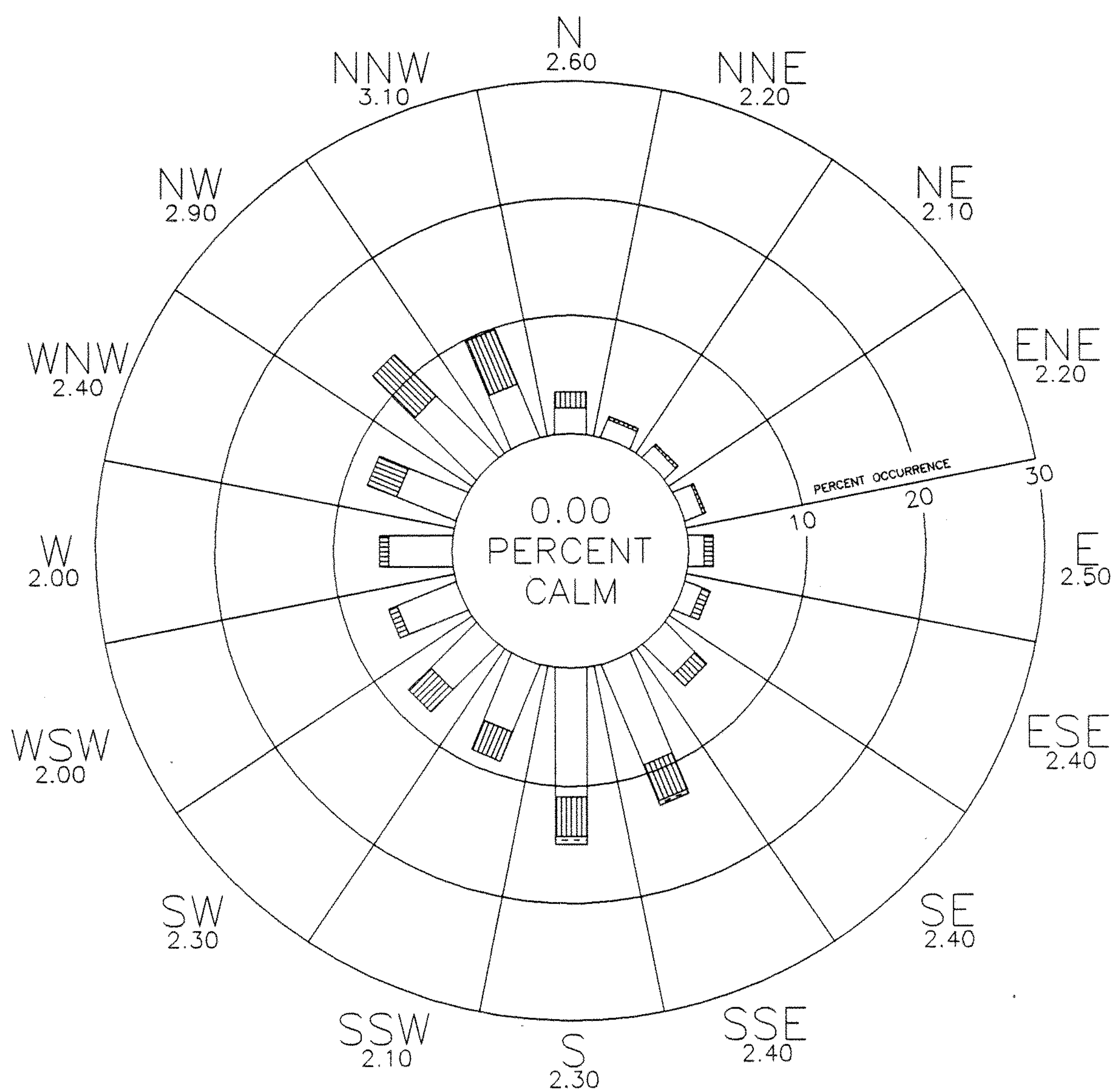


Figure 4-1

Comparison of annual radiation doses in millirem to an average member of the U.S. population (NCRP, 1987) with the maximum dose to an off-site resident from 1989 WVDP effluents.



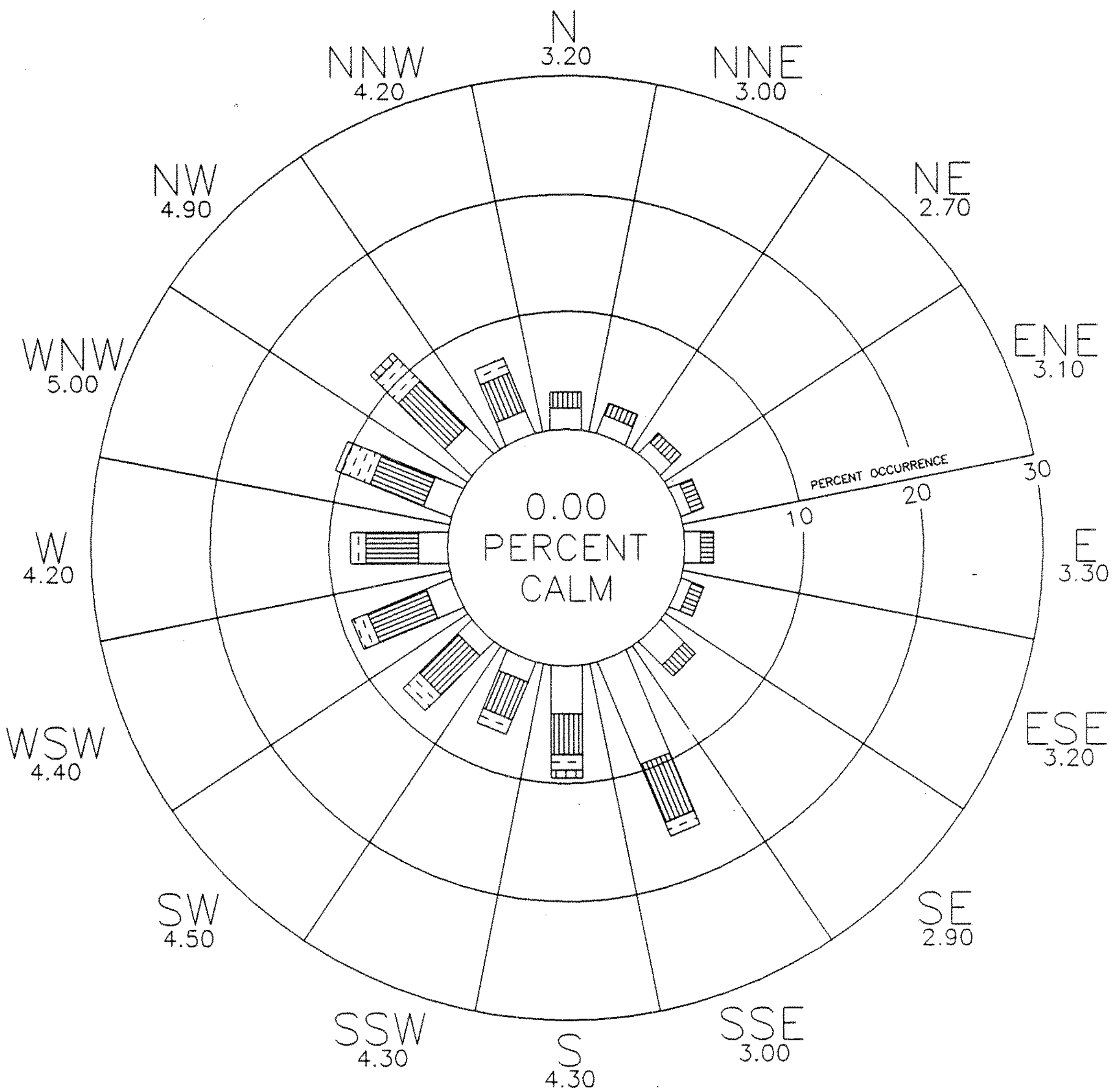
NUMBERS INDICATE SECTOR MEAN WIND SPEED

WIND SPEED RANGE:

- 0.0 – 3.0 M/SEC
- 3.0 – 6.0 M/SEC
- 6.0 – 9.0 M/SEC
- 9.0 – 12.0 M/SEC
- > 12.0 M/SEC

WEST VALLEY NUCLEAR SERVICES
PRIMARY MONITORING STATION
WEST VALLEY, NEW YORK

10.0-METER WIND FREQUENCY ROSE
JANUARY 1, 1989 – DECEMBER 31, 1989
FIGURE 4-2



NUMBERS INDICATE SECTOR MEAN WIND SPEED

WIND SPEED RANGE:

- 0.0 – 3.0 M/SEC
- 3.0 – 6.0 M/SEC
- 6.0 – 9.0 M/SEC
- 9.0 – 12.0 M/SEC
- > 12.0 M/SEC

WEST VALLEY NUCLEAR SERVICES
PRIMARY MONITORING STATION
WEST VALLEY, NEW YORK

60.0-METER WIND FREQUENCY ROSE
JANUARY 1, 1989 – DECEMBER 31, 1989
FIGURE 4-3

The dose reported above is 0.018% of the 25 mrem (0.25 mSv) standard and can be compared to about eight minutes of the annual background radiation received by an average member of the U.S. population.

4.2.2 Maximum Organ Dose

As a result of radioactivity in airborne emissions from the site during 1989, the maximally exposed off-site individual incurred an estimated dose equivalent of 0.046 mrem (0.00046 mSv) to the thyroid, the organ receiving the highest dose. Almost all of the dose was contributed by iodine-129. This dose is 0.061% of the 75 mrem (0.75 mSv) standard.

4. 2. 3 Revised National Emission Standards for Hazardous Air Pollutants (NESHAP) for 1990

Effective December 15, 1989, the EPA promulgated a revised standard of 10 mrem (0.1 mSv) effective dose equivalent (EDE) to any member of the public, replacing the 25 mrem (0.25 mSv) whole body dose equivalent standard. The organ dose standard will no longer be effective. While the revised standard is not applicable to the current reporting period, a dose assessment was performed using the new methodology incorporated in the revised NESHAP to facilitate the transition to the new standard. Both AIRDOS-PC (Version 3.0, 1989), an EPA-approved personal computer version of AIRDOS-EPA, and CAP-88, the EPA-approved replacement for CAAC, were used to estimate the dose to the maximally exposed off-site resident. Using 1989 meteorological and effluent data, an effective dose equivalent of 0.00073 mrem (0.0000073 mSv) was calculated using AIRDOS-PC and an EDE of 0.00023 mrem (0.0000023 mSv) was calculated using CAP-88. These doses are 0.0023% to 0.0073 % (for CAP-88 and AIRDOS-PC, respectively) of the revised standard and lower than the whole body dose calculated with CAAC by about a factor of ten. Most of the difference in calculated doses stems from the use of revised organ dose weighting factors and food consumption rates in the new codes. Because most of the dose is from iodine-129, a reduction in the thyroid weighting factor of about three reduces the EDE by a factor of three. The newer codes also incorporate average food consumption rates that are only one-third the maximum rates used in the CAAC. This results in another reduction by a factor of three in the EDE.

4.2.4 Collective Dose to the Population

The CAP-88 version (replacing the CAAC version) of AIRDOS-EPA was used to estimate the collective dose to the population. According to census projections, an estimated 1.7 million people reside within 80 km (50 miles)of the WVDP. This population received an estimated 0.0069 person-rem (0.000069 person-Sv) collective EDE from radioactive airborne effluents released from the WVDP during 1989. The resulting average EDE per individual is 0.0000041 mrem (0.000000041 mSv).

There are no regulations limiting collective doses to the population. However, the calculated average individual dose is 73 million times lower than (or an exposure less than one second of) the 300 mrem (3 mSv) that an average member of the U.S. population receives in one year from natural background radiation.

4.3 Estimated Radiological Dose from Liquid Effluents

As reported in Chapter 2, four batch releases of liquid radioactive effluents were monitored during 1989. The radioactivity that was discharged in these effluents is listed in Appendix C-1, Table C-1.1.

Dose Calculations

The computer code LADTAP II (Simpson and McGill, 1980) was used to calculate the dose to the maximally exposed off-site individual and the collective dose to the population from routine releases and dispersion of these effluents. Since the effluents eventually reach Cattaraugus Creek, which is not used as a source of drinking water, the local exposure pathway calculated by the code is from the consumption of 21 kg (46 lb) of fish caught in the creek. Population dose estimates assume that the radionuclides are further diluted in Lake Erie before reaching municipal drinking water supplies. A detailed description of LADTAP II is given in Yuan and Dooley, 1987.

Currently there are no EPA standards establishing limits on the radiation dose to members of the public from liquid effluents except as applied in the 40 CFR 141 and 40 CFR 143 Drinking Water Guidelines (USEPA 1984b,c). The potable water wells sampled for radionuclides are upgradient of the

West Valley Demonstration Project and are not considered a realistic pathway in the dose assessment. Since Cattaraugus Creek is not designated as a drinking water supply, the radiation dose estimated using LADTAP II was compared with the limits stated in DOE Order 5400.5.

4. 3. 1 Maximum Dose to an Off-Site Individual

Based on the radioactivity in liquid effluents released from the WVDP during 1989, an off-site individual was estimated to receive a maximum effective dose equivalent (EDE) of 0.051 mrem (0.00051 mSv). Approximately two-thirds of this dose is from cesium-137; the remainder comes from strontium-90 and carbon-14. This dose is about 6000 times lower than the 300 mrem (3 mSv) that an average member of the U.S. population receives in one year from natural background radiation – or an exposure of one and one-half hour.

No maximum organ dose was computed, as LADTAP II employs the risk-based methodology currently recommended by the ICRP rather than the critical organ methodology of the older International Commission on Radiological Protection (ICRP) guidance.

4. 3. 2 Collective Dose to the Population

As a result of radioactivity released in liquid effluents from the WVDP during 1989, the population living within 80 km (50 miles)of the site received a collective effective dose equivalent of 0.057 person-rem (0.00057 person-Sv). This estimate is based on a population of 1.7 million living within the 80 km radius. The resulting average effective dose equivalent per individual is 0.000034 mrem (0.000000034 mSv), or approximately 9 million times lower than the 300 mrem (3 mSv)that an average person receives in one year from natural background radiation – or an exposure of less than four seconds.

Although the collective dose from liquid effluents was twice as high in 1989 when compared to the previous year's estimate, a comparison of dose estimates from the past four years indicates that the general trend is downward.

4.4 Estimated Radiological Dose from All Pathways

The potential dose to the public from both airborne and liquid effluents released from the Project during 1989 is simply the sum of the individual dose contributions. The maximum effective dose equivalent from all pathways to a nearby resident was 0.056 mrem (0.00056 mSv). The total collective effective dose equivalent to the population within 80 km (50 miles) of the site was 0.064 person-rem (0.00064 person-Sv), with an average EDE of 0.000038 mrem (0.00000038 mSv) per individual.

The maximum dose to an individual was 0.056% of the 100 mrem (1 mSv) annual limit in DOE Order 5400.5. Figure 4-4 shows the trend in dose to the maximally exposed individual over the last four years. The contribution from airborne releases increased during 1989, but the total (airborne plus liquid) decreased from last year's estimate.

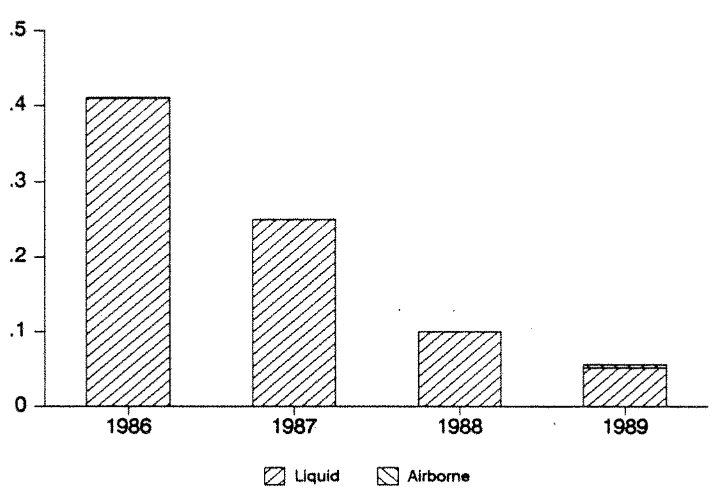


Figure 4-4

Maximum dose equivalent (mrem) from liquid and airborne effluents to an individual residing near the West Valley Demonstration Project.

Table 4-1: Summary of Dose Assessment From 1989 WVDP Effluents

	Maximum Dose to an Individual [1]	*Maximum Dose to the Population* [2]
Dose Equivalent from Airborne Emissions [3]	0.0046/0.046 mrem[4] (0.000046/0.00046 mSv)	0.0069 person-rem (0.000069 person-Sv)
EPA Radiation Protection Standards [5]	25/75 mrem[4]	-o-
(percent of standard)	(0.018%/0.061%)	
Dose Equivalent from Liquid Effluents [6]	0.051 mrem (0.00051 mSv)	0.057 person-rem (0.00057 person-Sv)
Dose Equivalent from All Releases	0.056 mrem (0.00056 mSv)	0.064 person-rem (0.00064 person-Sv)
DOE Radiation Protection Standard [7]	100 mrem	-o-
(percent of DOE standard)	(0.056%)	
Background Effective Dose Equivalent[8]	300 mrem(3 mSv)	510,000 person-rem (5100 person-Sv)
(percent of background)	(0.019%)	(0.000059%)

[1] Maximally exposed individual at a residence 1.9 km NNW from the main plant
[2] Population of 1.7 million within 80 km of the site
[3] Calculated using AIRDOS-EPA (CAAC for individual/CAP-88 for population)
[4] Whole body/maximum organ dose equivalents (collective dose is effective dose equivalent)
[5] Airborne emissions only (changed to 10 mrem EDE for 1990)
[6] Calculated using LADTAP II (effective dose equivalent)
[7] Applies to doses from both airborne and liquid effluents
[8] U.S. Average (Source: NCRP, 1987)

Table 4-1 on the opposing page summarizes the dose contributions from all pathways and compares the individual doses to the applicable standards.

Figure 4-5, the trend in collective dose to the population, shows an increase relative to last year's estimate, but is about the same as the 1987 estimate. These doses are still well below the regulatory limits.

4.5 Estimated Radiological Dose from Local Food Consumption

In addition to dose estimates based on dispersion modeling, the maximum EDE to a nearby resident from consumption of locally produced food was also estimated. Because the estimated doses using the computer models already incorporate the food pathway, the following doses should not be added to doses reported in previous sections but should serve as an additional means to measure the impact of Project operations.

Near-site and control samples of fish, milk, beef, venison, fruit, and vegetables were collected. The samples were analyzed for various radionuclides, including tritium, potassium-40, cobalt-60, strontium-90, iodine-129, cesium-134 and cesium-137. The measured radionuclide concentrations reported in Tables C-3.1 through C-3.4 are the basis for these dose estimates.

With the exception of milk samples, all radionuclide concentrations are reported in terms of the dry sample weight. Prior to any dose calculations the concentration per wet weight was calculated by factoring in the moisture content of the samples.

When statistically significant differences were found between near-site and background sample concentrations, the excess near-site sample concentration was used as a basis for the dose estimate. Most of the measured radionuclides were found to be under the minimum detectable concentration (MDC). When this was the case for both near-site and control samples, the concentrations in both were assumed to be at background levels.

The EDE to a nearby resident from the consumption of foods with radionuclide concentrations found to be above background concentration was estimated. The potential dose was calculated by multiplying the excess concentration by the maximum adult annual consumption rate for each food and the ingestion unit dose factor for the measured radionuclide. The consumption rates are based on site-specific data and recommendations in the NRC Regulatory Guide 1.109 for terrestrial food chain dose assessments (USNRC, 1977). The internal dose conversion factors were obtained from DOE/EH-0071 (USDOE, 1988).

The results of the dose estimates for each food type are reported in the following sections. The four-year trend in total EDE from consumption of all the sampled food products is plotted in Figure 4-6. All of the calculated doses are well below both the EPA and DOE limits discussed in the previous sections.

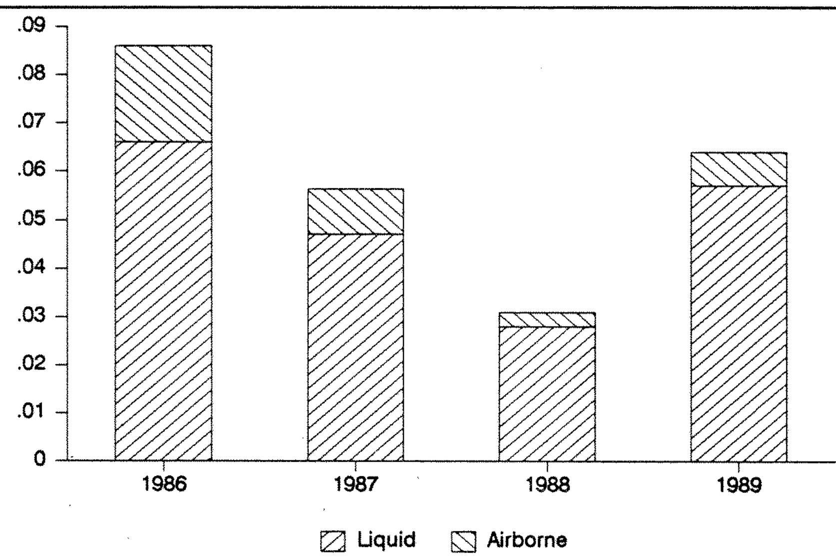


Figure 4-5

Collective dose equivalent (person-rem) from liquid and airborne effluents to the population residing within 80 km of the West Valley Demonstration Project.

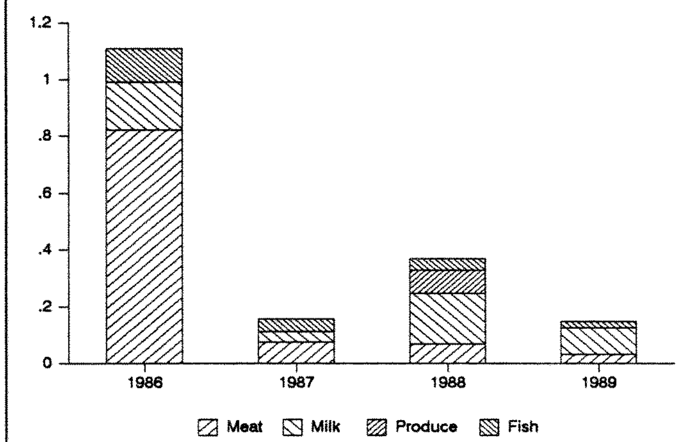


Figure 4-6

Maximum effective dose equivalent (mrem) to an individual from consumption of foods produced near the West Valley Demonstration Project.

4.5.1 Milk

Milk samples were collected from various nearby dairy farms throughout 1989. Control samples were collected from farms 25-30 km (15-20 miles) to the south and north of the WVDP. As reported in Table C-3.1, milk samples were measured for tritium, strontium-90, iodine-129, cesium-134, and cesium-137. Only tritium and strontium-90 were found above minimum detectable concentration (MDC) levels in near-site samples. To obtain a conservative estimate, the average background concentration was subtracted from the near-site sample with the highest reported concentration. Based on an annual consumption rate of 310 liters (327 quarts), the maximum effective dose equivalent from drinking this milk was estimated to be 0.092 mrem (0.00092 mSv). The highest organ dose equivalent to bone surfaces was estimated to be 1.1 mrem (0.011 mSv).

4.5.2 Beef

Near-site and control samples of locally raised beef were collected during middle and late 1989. As reported in Table C-3.2, these samples were measured for strontium-90, cesium-134, cesium-137, and potassium-40 concentrations. Samples are analyzed for potassium-40 because it provides a built-in calibration spike from a natural isotope of potassium not released in Project effluents. Only strontium-90 was detected above minimum detectable concentration levels in near-site samples, with the highest excess concentration reported in beef sampled during late 1989. Based on an annual consumption rate of 110 kg (242 lb), the maximum effective dose equivalent from eating this meat was estimated to be 0.033 mrem(0.00033 mSv). The highest organ dose equivalent to bone surfaces was estimated to be 0.41 mrem (0.0041 mSv).

4.5.3 Venison

Meat samples from three near-site and three control deer were collected in the last months of 1989. As reported in Table C-3.2, these samples were measured for strontium-90, cesium-134, cesium-137, and potassium-40 concentrations. Strontium-90 and cesium-137 were detected above minimum detectable concentration levels; however, average concentrations in background specimens were slightly higher than average concentrations in near-site specimens.

4.5.4 Produce (Beans, Tomatoes, and Corn)

Near-site and control samples of beans, tomatoes, and corn were collected in 1989. As reported in Table C-3.3, these samples were measured for tritium, strontium-90, potassium-40, cobalt-60 and cesium-137 concentrations. In all cases either the radionuclides were below MDC levels, or no statistically significant differences were found between near-site and control specimens.

4.5.5 Fish

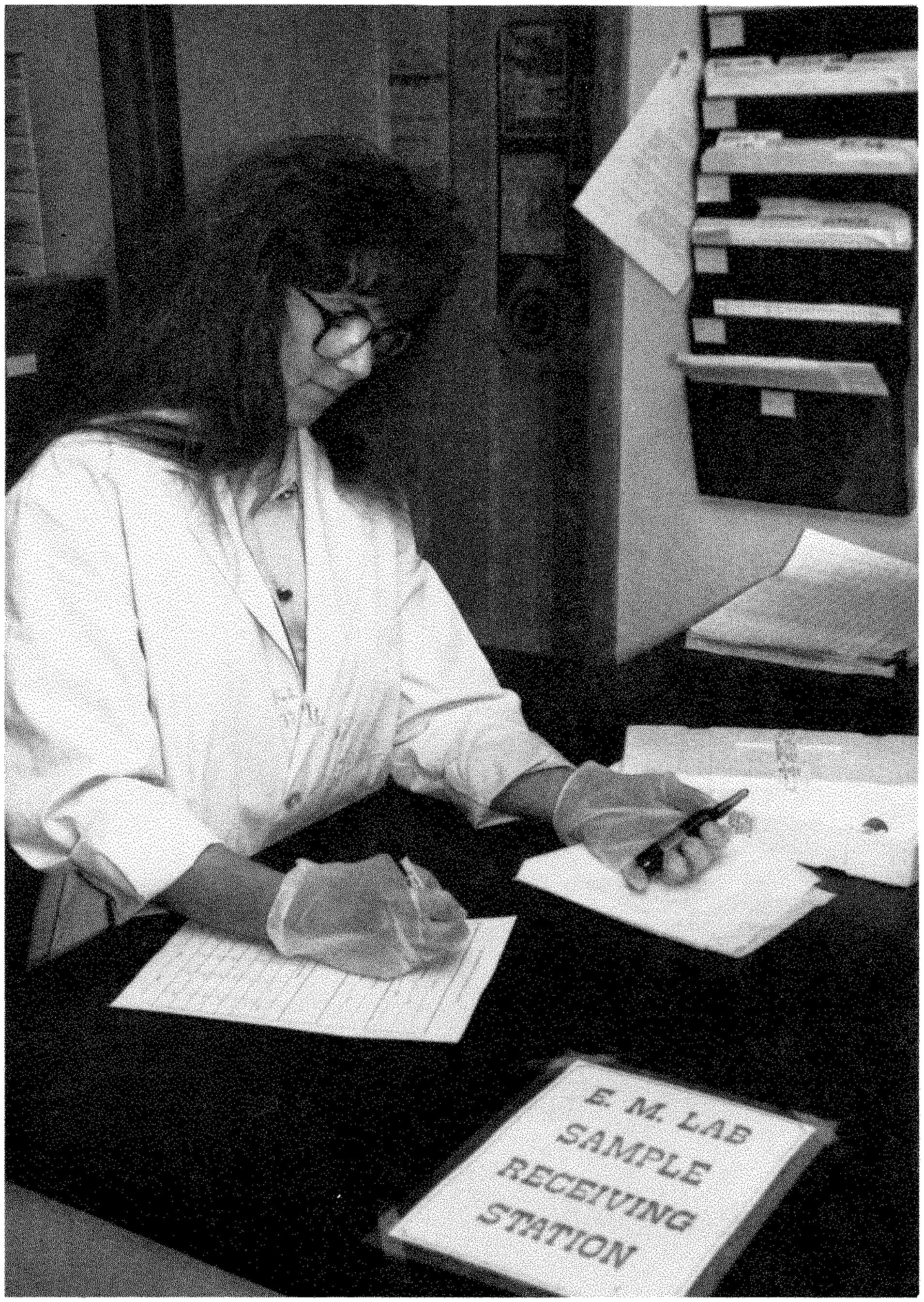
Fish were caught in the second and third quarters of 1989 in Cattaraugus Creek upstream (control samples) and downstream (above and below the Springville dam) of the site. As reported in Table C-3.4, samples of fish flesh were measured for strontium-90, cesium-134 and cesium-137 concentrations. Only strontium-90 was detected above MDC levels, with the highest excess concentration reported in fish caught during the second quarter upstream of the Springville dam. Based on an annual consumption rate of 21 kg (46 lb), the maximum effective DE from eating this fish was estimated to be 0.023 mrem (0.00023 mSv). This compares fairly well with the 0.051 mrem (0.00051 mSv) estimated using the LADTAP II liquid effluent dispersion code. The highest organ DE (to bone surfaces) was estimated to be 0.29 mrem 0.0029 mSv).

4.6 Statistical Analysis Of Air Sampler Data

Environmental air samplers that measure gross alpha, gross beta, strontium-90, and cesium-137 concentrations are located near the site and at background locations. (See Tables C-2.12 through C-2. 20). To see if any measurable increases in airborne radionuclide concentrations could be detected in the air sampler data, a simple one-way analysis of variance (ANOVA) statistical test was performed. At the 99% confidence level only the Springville sampler showed statistically significant differences from the other sampler data. This difference was attributed to a faulty gas meter which has since been replaced. The Thomas Corners Road sampler, located between the site and the Springville sampler, showed no difference from background samplers. Concentrations measured at the Springville sampler since the repair date have returned to historically normal levels. Based on results drawn from the dispersion models, average concentrations of radionuclides contributed by Project airborne effluents would be five orders of magnitude below the measured background levels at the sampler locations. Such small increments are impossible to detect within the variability of background radionuclide concentrations in air.

4.7 Conclusions

In summary, the dose assessment shows that during 1989 the West Valley Demonstration Project was in compliance with all applicable emission standards and dose limits. The doses to the public estimated from effluent dispersion models and radionuclide concentrations in food samples were well below these limits, resulting in no measurable effects on the public's health.



LOGGING A CROSSCHECK SAMPLE

5.0 Standards And Quality Assurance

5.1 Quality Control

Ensuring that the environmental samples and laboratory analyses of these samples are of the highest quality is obviously an important feature of the West Valley Demonstration Project's environmental monitoring program. To achieve the necessary standards, the WVDP follows certain procedures. These include:

- standardized collection procedures that ensure timely collection of representative and appropriate samples
- standardized preparation procedures that ensure reproducible tests
- analytical measurement procedures commonly used at other facilities
- instrument calibrations using NIST (National Insitute of Standards and Technology) traceable standards
- procedures that allow all sample data to be analyzed in the same fashion
- appropriate training of analytical personnel
- evaluation and response procedures that ensure consistent response to the results of sample analyses
- use of both on-site and off-site laboratories to provide crosscheck analyses of samples
- use of blind samples as analytic controls
- documenting that the off-site laboratories adhere to standards and regulations pertinent to handling and storing samples, keeping records, evaluating data, employing qualified personnel, and providing precision and accuracy in the analyses of samples.

Off-Site Laboratories

Off-site laboratories performed most of the analyses requiring radiochemical separation or chemical pollutant analyses for the environmental samples collected during 1989. The documented quality assurance plan used by these laboratories includes periodic interlaboratory crosschecks, prepared standard and blank analyses, routine instrument calibration, and use of standardized procedures. Off-site laboratories analyze blind duplicates of about 10% of the samples analyzed on-site. Simlarly, crosscheck samples are provided by the WVDP Environmental Laboratory.

To ensure that the three contract laboratories followed standard procedures, Project personnel visited each facility as part of the process of qualifying off-site laboratory services. The results of the audits demonstrated that one of the laboratories was not meeting all requirements contractually imposed. No further analyses were performed by this laboratory for the remainder of 1989. It is anticipated that upon successful completion of corrective action and verification, the use of this laboratory will resume in 1990.

The WVDP Environmental Laboratory

Sample collection, preparation, and most direct radiometric analyses were performed at the WVDP Environmental Laboratory. All continuous sampling equipment, measurement devices, and counting instruments were routinely calibrated using standards traceable to the National Institute of Standards and Technology. Specific calibration schedules and operation checks are required and were met in 1989 for critical instruments.

Sampling protocols based on the EPA requirements for nonradiological analyses were set up specifically for groundwater collection. Other collections such as surface water, sediments, and biological samples met standard laboratory procedures and surveillance program schedules. Sampling methods are periodically observed, reviewed, and evaluated in practice by senior laboratory personnel as well as outside agencies such as the Nuclear Regulatory Commission and the New York State Department of Environmental Conservation.

Crosscheck Programs

Formal crosscheck programs between the WVDP Environmental Laboratory, the Department of Energy's Radiological and Environmental Science Laboratory at the Idaho National Engineering Laboratory (INEL), the EPA Environmental Monitoring Systems Laboratory in Las Vegas (EMSL), the New York State Department of Health Environmental Laboratory Accreditation Program (NYSDOH ELAP), and the Nuclear Regulatory Commission's Environmental Measurements Laboratory (EML), New York City, included the entire range of environmental sample types monitored in 1989.Tables 1-6 in Appendix D report the results of these crosscheck samples.

- Table D-1 compares data from a variety of environmental media analyzed at WVDP, off-site contract labs, and the Environmental Monitoring Laboratory (EML). Of the thirty analyses of air, soil,vegetation, and water samples reported in Table D-1 for the EML, two uranium-238 samples and one plutonium-239 sample fell outside the "passing" range as determined by EML. The three samples were analyzed by a contract laboratory. The overall test results, including all analyses, averaged a ratio of 1.15, a 90% passing rate.

- Table D-2 summarizes the crosscheck comparison results between the WVDP and the EPA's EMSL for radiological parameters. The passing rate for this round of testing was 89.5% for those samples reported. Five analyzed samples are not reported in the table because the results were not reported by the internal deadline from the contract laboratory. The overall agreement, as represented by the average ratio of 0.95, was quite good.

- Table D-3 gives the crosscheck results from the INEL's gamma-in-water sample. These represent a 100% passing rate for the samples, with an average ratio of 0.98.

- Tables D-4 and D-5 summarize comparisons of water quality parameters in quality assurance samples between the WVDP and NYSDOH ELAP. Combined NYSDOH ELAP crosscheck results for both January and July 1989 corresponded to a 97% passing rate with an average ratio of 1.01, an excellent result.

- Table D-6 demonstrates acceptable agreement between the WVDP laboratory and the NRC for thermoluminiscent dosimeters (TLDs) colocated at eight points around the site. The 1989 comparison ratio is 1.12 for the two systems of TLDs. It should be noted that Project dosimetry is consistently placed at a height of one meter, but the NRC dosimeters are usually placed at 1.5 to 3 meters. This difference in placement may partially account for the variances.

The total number of 118 blind quality assurance parameters and crosschecks measured and reported in 1989 demonstrated an acceptable program with an overall passing rate of 94.0%.

As shown by the various audit and crosscheck results, the WVDP Environmental Monitoring Program is functioning well. The improvements in 1989 have been reflected in a very satisfactory crosscheck record.

5.2 Statistical Reporting

Except where noted, individual analytical results are reported with plus or minus two standard deviations, giving a value at the 95% confidence level. The arithmetic averages were calculated using actual results, including zero and negative values. In the final results, if the uncertainty was equal to or greater than the value, the measurement was considered to be below the minimum detectable concentration (MDC). A result below the MDC is reported as a less-than (<) value. These MDC values will vary among samples, especially in biological media where sample size cannot be easily standardized.

The total statistical uncertainty for radiological measurements, including systematic (processing and physical measurement) uncertainty plus the random radioactivity counting uncertainty, is reported as one value for the 1989 data. In most cases, systematic uncertainties such as those due to laboratory glassware or analytical balance variation are a small percentage of the larger counting uncertainties at typical environmental levels of radioactivity. The notation normally used in reporting raw laboratory data to convey the total uncertainty is the form V.00 plus or minus R.0 or T.0 E-00, where V.00 is the analytical value to three significant figures, R.0 is the random uncertainty to two significant figures, T.0 is the total of random plus systematic uncertainties, and E-00 is the exponent of 10 used to signify the magnitude of the parenthetical expression. (For examples of this notation see Appendices C1 - C3).

For unique or individual samples analyzed on an infrequent basis, generic minimum detection limits for the entire analytical measurement protocol have not been developed. A lower limit of detection (LLD) based solely on the counting uncertainty (i.e., the statistical margin of error) is calculated for each sample size, equipment, and preparation technique. An average minimum detectable concentration has been calculated for WVDP environmental samples. These are listed in Table 5.1.

5.3 Environmental Standards and Regulations

The following environmental standards and laws are applicable, in whole or in part, to the WVDP:

DOE Order 5400.1, "General Environmental Protection Program," November 1988.

DOE Order 5480.1, "Requirements for Radiation Protection," August 1981.

DOE Order 5480.1A, "Environmental Protection, Safety, and Health Protection Program for DOE Operations," August 1981.

DOE Order 5484.1, "Environmental Protection, Safety, and Health Protection Information Reporting Requirements," February 1981.

Clean Air Act, 42 USC 1857 et seq., as amended,and implementing regulations.

Federal Water Pollution Control Act (Clean Water Act), 33 USC 1251, as amended, and implementing regulations.

Resource Conservation and Recovery Act, 42 USC 6905, as amended, and implementing regulations.

National Environmental Policy Act, PL 911-190, 42 USC 4321-4347, January 1, 1970, as amended, and implementing regulations.

Comprehensive Environmental Response, Compensation, and Liability Act, 42 USC 960, (including Superfund Amendments and Reauthorization Act of 1986), and implementing regulations.

Toxic Substances Control Act, 15 USC 2610, as amended, and implementing reghulations.

Environmental Conservation Law of New York State.

The standards and guidelines applicable to releases of radionuclides from the WVDP are found in DOE Order 5400.5.

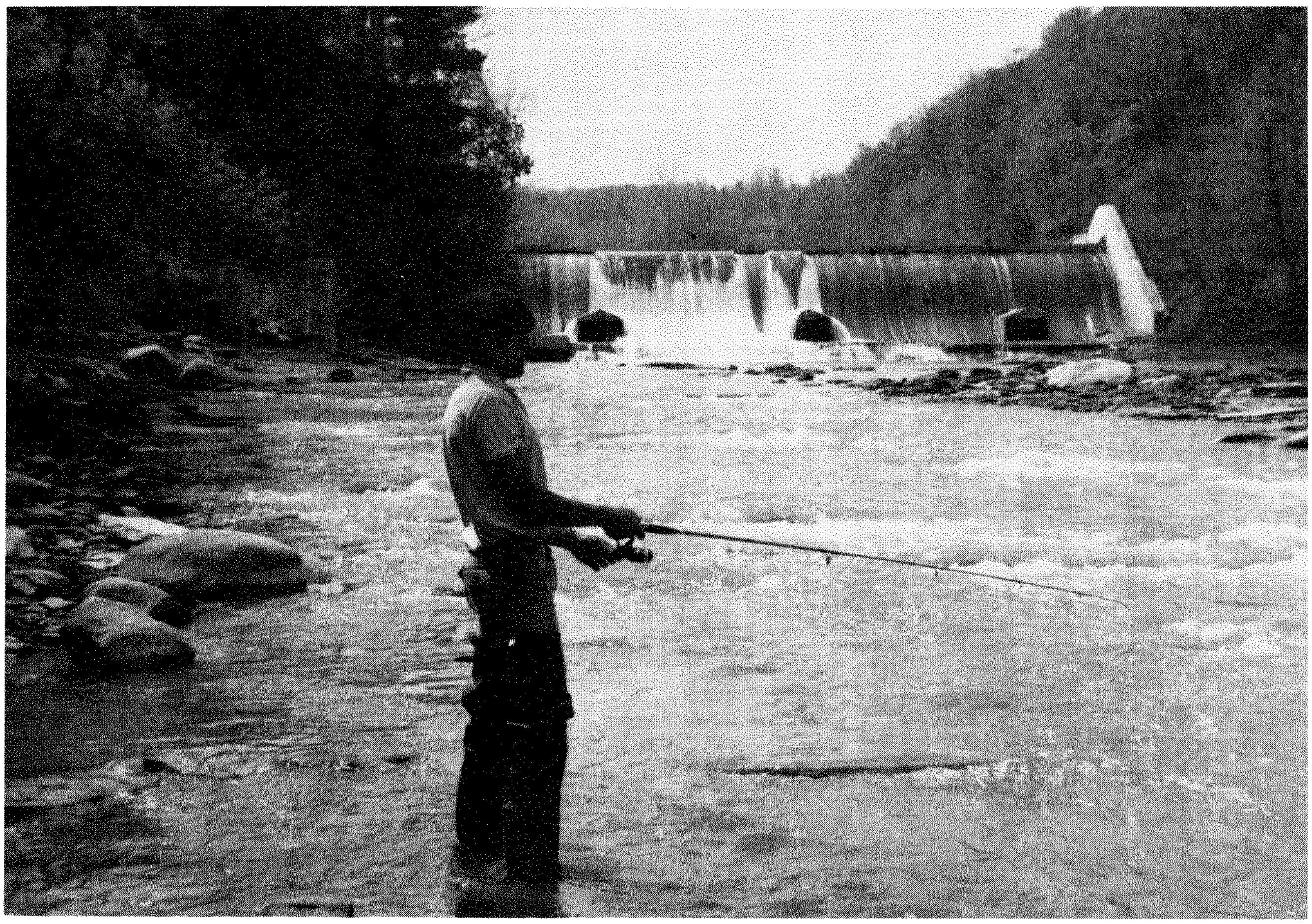
Radiation protection standards and selected radionuclide limitations from the Derived Concentration Guides are listed in Appendix B. These listed concentration guides are provided by the Department of Energy to ensure compliance with the performance standard of 100 mrem effective dose equivalent to the hypothetical maximally exposed individual.

Ambient water quality standards contained in the State Pollutant Discharge Elimination System (SPDES) permit issued for the facility are listed in Table C5 -2 in Appendix C. Airborne discharges are also regulated by the EPA under the National Emission Standards for Hazardous Air Pollutants, 40 CFR 61, 1984.

Table 5-1

Minimum Detectable Concentrations for Routine Samples

Measurement	Medium	Sample Size	MDC
Gross Alpha	Water	1 L	8.1 E-10 μCi/mL
Gross Beta	Water	1 L	7.7 E-10 μCi/mL
Cesium-137	Water	500 ml	1.0 E-08 μCi/mL
H-3	Water	5 ml	1.0 E-07 μCi/mL
Sr-90	Water	1 L	1.6 E-09 μCi/mL
Gross Alpha	Air	400 cu. m	7.0 E-16 μCi/mL
Gross Beta	Air	400 cu. m	7.0 E-15 μCi/mL
Cs-137	Air	400 cu. m	1.4 E-14 μCi/mL
Gross Alpha	Soil	100 mg	5.5 E-06 μCi/g
Gross Beta	Soil	100 mg	5.3 E-06 μCi/g
Cs-137	Soil	350 g	6.3 E-08 μCi/g



HOPING FOR A LARGE FISH SAMPLE

APPENDIX A

EFFLUENT ON-SITE AND OFF-SITE MONITORING PROGRAM

1989 EFFLUENT ON-SITE AND OFF-SITE MONITORING PROGRAM

The following schedule represents the West Valley Demonstration Project's routine environmental monitoring program which was in place in 1989. This schedule meets or exceeds the minimum program needed to satisfy the requirements of the Department of Energy (DOE) Order 5400.1, which superseded DOE 5484.1A, Chapter III, in late 1988. It also meets requirements of further DOE 5400 orders currently being drafted. Specific methods and recommended monitoring program elements are found in DOE/EP-0096, "Effluent Monitoring," and DOE/EP-0023, "Environmental Surveillance," which are the bases for selecting most of the schedule specifics. Additional monitoring is mandated by Operational Safety Requirements (OSRs) and air and water discharge permits (40 CFR 61 and SPDES), which also require a formal report. These specific cases are identified in the schedule under MONITORING/REPORTING REQUIREMENTS. The overall environmental program schedule is referenced in OSR/TR-GP-4.

Summary of Monitoring Program Changes Implemented in 1989

Significant 1989 program changes were limited to collecting samples from new sample points and to changes in frequency of sampling and analyses, in response to changes in regulations coming into effect in late 1988 and in 1989.

Schedule of Environmental Sampling

The following table is a schedule of environmental sampling at the West Valley Demonstration Project. Locations of the sampling points are shown in Figures A-1 through A-9. The index below is a list of the codes for the various sample locations. Table headings in the schedule are as follows:

- **Sample Location and ID code.** *The physical location from which the sample is collected is described. The ID is a seven-character code: The first character identifies the sample medium as* A*ir,* W*ater,* S*oil/Sediment,* B*iological, or* D*irect Measurement. The second character specifies o*N*-site or o*F*f-site location. The remaining characters describe the specific location (e.g., AFGRVAL is* A*ir, o*F*f-site, at* **GR***eat* **VAL***ey).*

- **Monitoring/Reporting Requirements.** *The basis for monitoring that location and any additional references to permits or OSRs are noted, as well as the reports generated from the sample data.*

- **Sampling Type/Medium.** *This describes the collection method and the physical characteristics of the medium.*

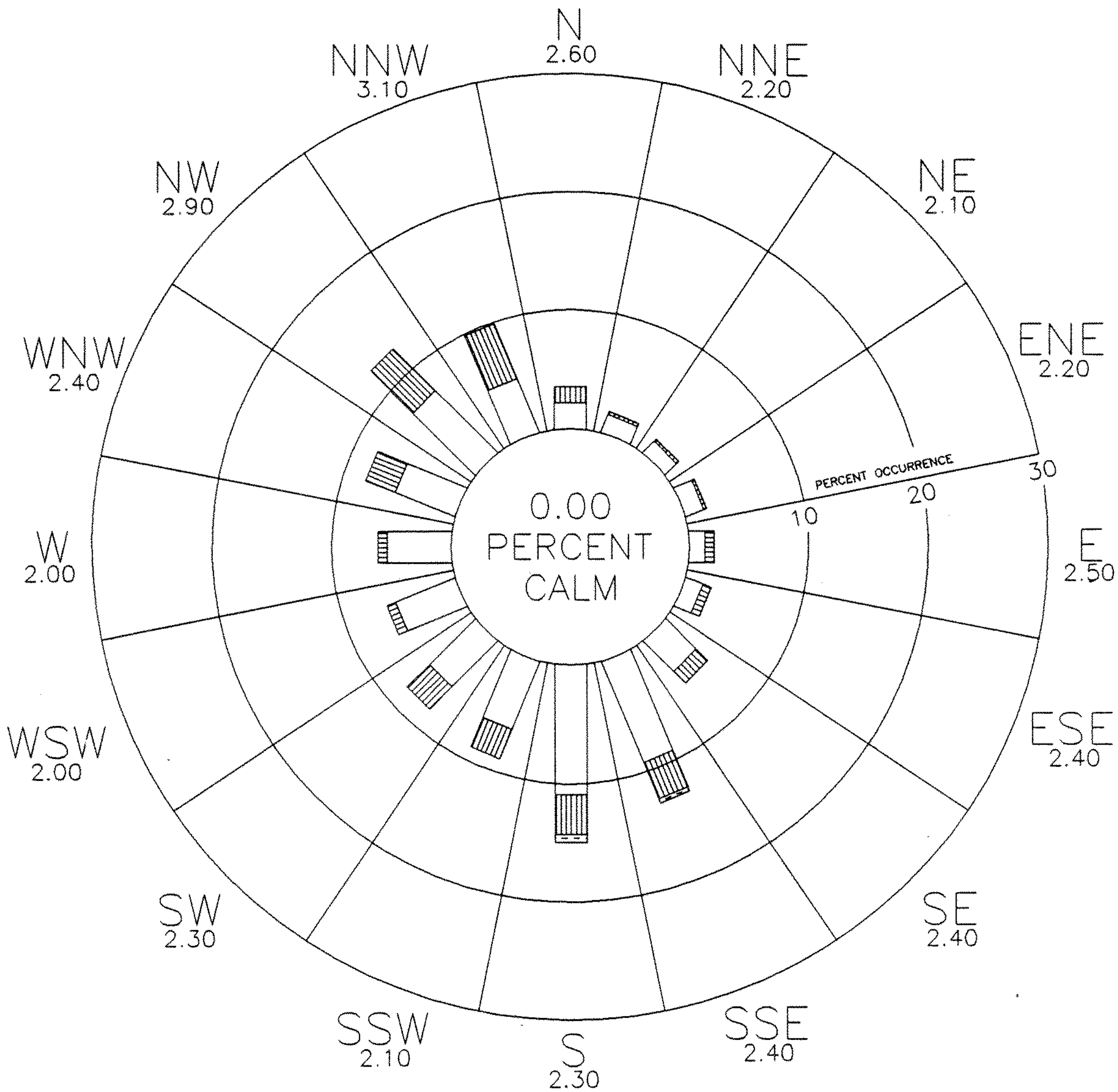
- **Collection Frequency.** *Indicates how often the samples are collected or retrieved.*

- **Total Annual Samples.** *The number of discrete physical samples collected annually, not including composites of collected samples, is noted.*

- **Analysis Performed/Composite Frequency.** *The individual analyses of the samples or composites of samples and the frequency of analyses is described.*

Index of Environmental Monitoring Program Sample Points

* Not detailed on map



NUMBERS INDICATE SECTOR MEAN WIND SPEED

WIND SPEED RANGE:

- 0.0 – 3.0 M/SEC
- 3.0 – 6.0 M/SEC
- 6.0 – 9.0 M/SEC
- 9.0 – 12.0 M/SEC
- > 12.0 M/SEC

WEST VALLEY NUCLEAR SERVICES
PRIMARY MONITORING STATION
WEST VALLEY, NEW YORK

10.0-METER WIND FREQUENCY ROSE
JANUARY 1, 1989 – DECEMBER 31, 1989
FIGURE 4-2

Index of Environmental Monitoring Program Sample Points

Off-Site Ambient Air (Figure A-6)

Off-Site Soil/Sediment*

Off-Site Biological (Figures A-5 and A-9)

Direct Measurement Dosimetry : Thermoluminescent LiF Dosimeters (Figures A-7, A-8, and A-9)

* Not detailed on map

1989 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Main Plant Ventilation Exhaust Stack **ANSTACK**	Airborne radioactive effluent point including LWTS and Vitrification Off-Gas	Continuous off-line air particulate monitor	Continuous measurement of fixed filter, replaced weekly	N/A	Real time alpha and beta monitoring
Supernatant Treatment System (STS) Ventilation Exhaust **ANSTSTK**	Required by: OSR/TR-GP-1 40 CFR 61	Continuous off-line air particulate filter	Weekly	104 (52 per location)	Gross alpha/beta, gamma isotopic.* Quarterly composite for Sr-90, Pu/U isotopic, Am-241, gamma isotopic
	Reported: Monthly Environmental Monitoring Trend Analysis	Continuous off-line desiccant column for water vapor collection	Weekly	104 (52 per location)	H-3
	Annual Effluent and On-Site Discharge Report	Continuous off-line charcoal cartridge	Weekly	104 (52 composited to 4 per location)	Quarterly composite for I-129
	Annual Environmental Monitoring Report				
	Air Emission Annual Report (NESHAP)				

* Weekly gamma isotopic only if gross activity rises significantly

1989 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Cement Solidification System (CSS) Ventilation Exhaust **ANCSSTK**	Airborne radioactive effluent point Required by: OSR/TR-GP-1 40 CFR 61	Continuous off-line air particulate monitor	Continuous measurement of fixed filter, replaced weekly	N/A	Real time alpha and beta monitoring
Contact Size Reduction Facility Exhaust **ANCSRFK**	Reported: Monthly Environmental Monitoring Trend Analysis	Continuous off-line air particulate filter	Weekly	104 (52 per location)	Gross alpha/beta, gamma isotopic.* Quarterly composite for Sr-90, Pu/U isotopic, Am-241, gamma isotopic.
	Annual Effluent and On-site Discharge report	Continuous off-line charcoal cartridge.	Weekly	104 (52 composited to 4 per location)	Quarterly composite for I-129
	Annual Environmental Monitoring Report				
	Air Emissions Annual Report (NESHAP)				

*Weekly gamma isotopic only if gross activity rises significantly.

1989 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Supercompactor Exhaust **ANSUPCV**	Airborne radioactive effluent point Required by: OSR/TR-GP-1 40 CFR 61 Reported: Monthly Environmental Monitoring Trend Analysis Annual Effluent and On-site Discharge Report Annual Environmental Monitoring Report Air Emissions Annual Report (NESHAP)	Continuous off-line air particulate monitor during operation (maximum of 26 operating weeks expected)	Continuous measurement of fixed filter, collected and replaced every seven operating days, or at least monthly when unit is operated	N/A 26 26 composited to 4	Real time beta monitoring Filters for gross alpha/beta, gamma isotopic* upon collection Quarterly composites: filters for Sr-90, Pu/U isotopic, Am-241, gamma isotopic

* Weekly gamma isotopic only if gross activity rises significantly.

Table 4-1: Summary of Dose Assessment From 1989 WVDP Effluents

	Maximum Dose to an Individual [1]	*Maximum Dose to the Population* [2]
Dose Equivalent from Airborne Emissions [3]	0.0046/0.046 mrem[4] (0.000046/0.00046 mSv)	0.0069 person-rem (0.000069 person-Sv)
EPA Radiation Protection Standards [5]	25/75 mrem[4]	-o-
(percent of standard)	(0.018%/0.061%)	
Dose Equivalent from Liquid Effluents [6]	0.051 mrem (0.00051 mSv)	0.057 person-rem (0.00057 person-Sv)
Dose Equivalent from All Releases	0.056 mrem (0.00056 mSv)	0.064 person-rem (0.00064 person-Sv)
DOE Radiation Protection Standard [7]	100 mrem	-o-
(percent of DOE standard)	(0.056%)	
Background Effective Dose Equivalent[8]	300 mrem(3 mSv)	510,000 person-rem (5100 person-Sv)
(percent of background)	(0.019%)	(0.000059%)

[1] Maximally exposed individual at a residence 1.9 km NNW from the main plant
[2] Population of 1.7 million within 80 km of the site
[3] Calculated using AIRDOS-EPA (CAAC for individual/CAP-88 for population)
[4] Whole body/maximum organ dose equivalents (collective dose is effective dose equivalent)
[5] Airborne emissions only (changed to 10 mrem EDE for 1990)
[6] Calculated using LADTAP II (effective dose equivalent)
[7] Applies to doses from both airborne and liquid effluents
[8] U.S. Average (Source: NCRP, 1987)

Table 4-1: Summary of Dose Assessment From 1989 WVDP Effluents

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(percent of standard)	(0.018%/0.061%)	
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DOE Radiation Protection Standard [7]	100 mrem	-o-
(percent of DOE standard)	(0.056%)	
Background Effective Dose Equivalent[8]	300 mrem(3 mSv)	510,000 person-rem (5100 person-Sv)
(percent of background)	(0.019%)	(0.000059%)

[1] Maximally exposed individual at a residence 1.9 km NNW from the main plant
[2] Population of 1.7 million within 80 km of the site
[3] Calculated using AIRDOS-EPA (CAAC for individual/CAP-88 for population)
[4] Whole body/maximum organ dose equivalents (collective dose is effective dose equivalent)
[5] Airborne emissions only (changed to 10 mrem EDE for 1990)
[6] Calculated using LADTAP II (effective dose equivalent)
[7] Applies to doses from both airborne and liquid effluents
[8] U.S. Average (Source: NCRP, 1987)

1989 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Erdman Brook at Security Fence **WNSP006**	Combined facility liquid discharge Required by: OSR/TR-GP-2 Reported: Monthly Environmental Monitoring Trend Analysis Annual Environmental Monitoring Report	Continuous proportional sample liquid	*Weekly	52	Gross alpha/beta, H-3, pH, conductivity. Monthly composite: gamma isotopic and Sr-90. Quarterly composite: C-14, I-129, Pu/U isotopic, Am-241.
Sanitary Waste Discharge **WNSP007**	Liquid effluent point for sanitary and utility plant combined discharge	24 hour composite liquid	3/month	36	Gross alpha/beta, H-3, suspended solids, NH_3, BOD-5, Fe
	Required by: SPDES Permit	Grab liquid	Weekly	52	pH, settleable solids
	Reported: Monthly NPDES DMR	Grab liquid	Annually	1	Chloroform
	Monthly Environmental Monitoring Trend Analysis Annual Effluent and On-site Discharge Report Annual Environmental Monitoring Report	In-line monitor with alarm	Continuous	N/A	pH

*Samples were collected simultaneously for NYSDOH.

1989 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
N.E. Swamp Drainage **WNSWAMP***	Site surface drainage	Grab liquid	Monthly	24 (12 per location)	Gross alpha/beta, H-3, pH
North Swamp Drainage **WNSW74A**	Reported: Annual Effluent and On-site Discharge Report				
French Drain **WNSP008**	Drains subsurface water from LLWT Lagoon area	Grab liquid	3/month	36	pH, conductivity, BOD-5, Fe
	Required by: SPDES Permit		Monthly	12	Gross alpha/beta, H-3
	Reported: Monthly NPDES DMR		Annually	1	Ag,Zn
	Annual Effluent and On-Site Discharge Report				
	Annual Environmental Monitoring Report				

*Samples collected simultaneously for NYSDOH.

1989 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Condensate and Cooling Water Ditch **WNSP005**	Combined drainage from facility yard area Reported: Internal Review	Grab liquid	Monthly	12	Gross alpha/beta, H-3, pH
Cooling Tower Basin **WNCOOLW**	Cools plant utility steam system water Reported: Internal Review	Grab liquid	Monthly	12	Gross alpha/beta, H-3, pH
Site Potable Water **WNDRNKW**	Source of water within site perimeter	Grab liquid	Monthly	12	Gross alpha/beta, H-3, pH, conductivity
	Reported: Internal Review		Annually	2	Toxic metals, pesticides chemical pollutants
SDA Holding Lagoon **WNSP003**	State Disposal Area Holding Lagoon Reported: Annual Environmental Monitoring Report NYSERDA	Grab liquid	Annually (as required)	1	Gross alpha/beta, H-3, C-14, pH, gamma isotopic, Sr-90, I-129, Pu/U isotopic

1989 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Frank's Creek E of SDA **WNFRC67**	Drains NYS Low-Level Waste Disposal Area	Grab liquid	*Monthly	12	Gross alpha/beta, H-3, pH
	Reported: Internal review NYSERDA				
Erdman Brook N of Disposal Areas **WNERB53**	Drains NYS and WVDP disposal areas	Grab liquid	Weekly	52	Gross alpha/beta, H-3, pH
	Reported: Internal review NYSERDA		*Monthly		
Ditch N of WVDP NDA & SDA **WNNDADR**	Drains WVDP disposal and storage area	Composite continuous liquid	Weekly	52	pH Monthly composite: gross alpha/beta, gamma isotopic, H-3. Quarterly composite: Sr-90, I-129
	Reported: Internal review Environmental Monitoring Trend Analysis				
Drainage S of Drum Cell **WNDCELD**	Reported: Internal review	Grab liquid	Weekly	52	pH Monthly composite: gross alpha/beta, gamma isotopic, H-3. Quarterly composite: Sr-90, I-129

*Samples were collected simultaneously for NYSDOH.

1989 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS**	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
On-site Standing Water (ponds not receiving effluent)	Water within vicinity of plant airborne or ground water effluent Reported: Internal Review	Grab liquid	Annually	7-10*	Gross alpha/beta, H-3, pH, conductivity, chloride, Fe, Mn, Na, phenols, sulfate
Test Pit N of HLW Area **WNSTAW1**					
Slough SW of RTS Drum Cell **WNSTAW2**					
Pond SE of Heinz Road **WNSTAW3**					
Border Pond S of AFRT240 **WNSTAW4**					
Border Pond SW of DFTLD13 **WNSTAW5**					
Borrow Pit NE of Project Facilities **WNSTAW6**					
Pond SW of Project Facilities W of Rock Springs Road **WNSTAW7**					
Slough N of Quarry Creek **WNSTAW8**					
North Reservoir Near Intake **WNSTAW9**					
Background Pond at Sprague Brook Maintenance Building **WNSTAWB**					

Number of points sampled will depend upon on-site ponding conditions during the year.

1989 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
On-site Groundwater	Groundwater monitoring wells around site solid waste management units	Grab liquid	4 times semiannually (8 samples yearly per well)**	144	Gross alpha/beta, H-3, gamma isotopic, chloride, sulfate, phenols, F, nitrate, TOC, TOH, As, Ba, Cs, Cr, Fe, Pb, Mn, Hg, Se, Ag, Na
HLW Tank GW Monitoring Unit - Wells: WNW 80-2 86-7 86-8 86-9 86-12* Surface: WNDMPNE*	Reported: Annual Environmental Monitoring Report	Direct measurement of sample discharge water	Before and after grab sample collection	288 (2 measurements per sample collection event)	Temperature, pH, conductivity
Lagoon GW Monitoring Unit - Wells: WNW 86-6 86-3 86-4 86-5 80-5 80-6 Surface: WNGSEEP WNSP008					
NDA GW Monitoring Unit - Wells: WNW 83-1D 86-10 86-11 82-1D					

*Serves former Cold Dump

**Sampling and analysis conducted as outlined in the RCRA Groundwater Technical Enforcement Guidance Document (EPA OSWER 9950.1) a the Statistical Analysis of Monitoring Data at RCRA Facilities (EPA/530-SW-89-026).

1989 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
On-site Groundwater	Groundwater monitoring wells around site facilities	Grab liquid	Semiannually	22* (2 per location)	Gross alpha/beta, H-3, gamma isotopic
Facility/Plant Area Wells: WNW 80-3 80-4	Reported: Annual Environmental Monitoring Report	Direct measurement of sample discharge water	Before and after grab sample collection	44* (two measurements per sample collection event)	Temperature, pH, conductivity
NDA Area Wells: WNW 82-1A 82-1B 82-1C 82-2B 82-2C 82-3A 82-4A1 82-4A2 82-4A3					
Fuel Storage Tank Subsurface Monitoring Well: WNW 86-13	Reported: Annual Environmental Monitoring Report	Grab liquid	Semiannually	2	Gross alpha/beta, H-3, gamma isotopic, phenols, TOC, benzene, toluene, xylene
		Direct measurement of discharge water	Before and after grab sample collection	4	Temperature, pH, conductivity

*Number of samples variable; occasionally wells are dry.

1989 OFF-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Cattaraugus Creek at Felton Bridge **WFFELBR**	Unrestricted surface waters receiving plant effluents Reported: Monthly Environmental Monitoring Trend Analysis Annual Environmental Monitoring Report	Flow weighted continuous liquid	Weekly *Weekly for monthly composite	52	Gross alpha/beta, H-3, pH. Monthly composite for gamma isotopic and Sr-90
Buttermilk Creek, Upstream of Cattaraugus Creek Confluence at Thomas Corners Road **WFBCTCB**	Restricted surface waters receiving plant effluents Reported: Annual Environmental Monitoring Report	Composite continuous liquid	*Biweekly	26	Monthly for gross alpha/beta, H-3, pH. Quarterly composite for gamma isotopic and Sr-90
Buttermilk Creek near Fox Valley **WFBCBKG**	Restricted surface water background Reported: Monthly Environmental Monitoring Trend Analysis Annual Environmental Monitoring Report	Composite continuous liquid	*Biweekly	26	Monthly for gross alpha/beta, H-3. Quarterly composite for gamma isotopic and Sr-90

*Samples are split with NYSDOH.

1989 OFF-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Wells near WVDP outside WNYNSC Perimeter 3.0 km WNW WFWEL01 1.5 km NW WFWEL02 4.0 km NW WFWEL03 3.0 km NW WFWEL04 2.5 km SW WFWEL05 29 km S WFWEL06 (background) 4.0 km NNE WFWEL07 2.5 km ENE WFWEL08 3.0 km SE WFWEL09 7.0 km N WFWEL10	Drinking supply groundwater near facility Reported: Annual Environmental Monitoring Report	Grab liquid	Biennially (Background well sampled annually)	6 (5 + background well each year of collection)*	Gross alpha/beta, H-3, gamma isotopic, pH, conductivity

*In 1989 all 10 wells were sampled.

1989 OFF-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
3.0 km SSE at Fox Valley **AFFXVRD**	Particulate air samples around WNYNSC perimeter	Continuous air particulate filter	Weekly	468 (52 per location)	Gross alpha/beta
3.7 km NNW at Thomas Corners Road **AFTCORD**	Reported: Annual Environmental Report				Quarterly composite for Sr-90, gamma isotopic
2.0 km NE on Route 240 **AFRT240+**	Monthly Environmental Monitoring Trend Analysis (four sites only+)	Continuous desiccant column for water vapor collection	Weekly (2 sites only**)	104 (52 per site)	H-3
1.5 km NW on Rock Springs Road **AFRSPRD**+**		Continuous charcoal cartridge	Weekly (2 sites only**)	104 (52 per site)	Quarterly composite for I-129
29 km S at Great Valley (background) **AFGRVAL**+**					
7 km N at Springville **AFSPRVL**					
6 km SSE at West Valley **AFWEVAL**					
50 km W at Dunkirk (background) **AFDNKRK**					
2.3 km SW on Dutch Hill Road **AFBOEHN+**					

1989 OFF-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
2.5 km SW **AFDHFOP** 3.0 km SSE **AFFXFOP** 3.7 km NNW **AFTCFOP** 2.0 km NE **AF24FOP**	Collection of fallout particulate and precipitation around WNYNSC perimeter Reported: Annual Environmental Report	Integrating liquid	Monthly	48 (12 per site)	Gross alpha/beta, H-3, pH
Surface Soil (at each of nine air samplers plus 26 km SSW at Little Valley) **SFSOL - Series**	Long-term fallout accumulation Reported: Annual Environmental Monitoring Report (year of collection)	Surface plug composite soil	Annually	10	Gamma isotopic, Sr-90, Pu-239, Am-241
Buttermilk Creek at Thomas Corners Road **SFTCSED****	Deposition in sediment downstream of facility effluents	Grab stream sediment	Semiannually 1st sample of SFBCSED and SFSDSED each spring*	10	Gross alpha/beta, isotopic gamma and Sr-90
Buttermilk Creek at Fox Valley Road (background) **SFBCSED**** Cattaraugus Creek at Springville Dam **SFSDSED** Cattaraugus Creek at Bigelow Bridge (background) **SFBISED** Cattaraugus Creek at Felton Bridge **SFCCSED**	Reported: Annual Environmental Monitoring Report		Annually (2 sites only**)	2	U/Pu isotopic, Am-241

*Sample to be split with NYSDOH.

**Analysis on one of two semiannual collections.

1989 OFF-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Cattaraugus Creek downstream of the Buttermilk Creek Confluence **BFFCATC**	Fish in waters downstream of facility effluents Reported: Annual Environmental Monitoring Report	Individual collection, biological	Semiannually *BFFCATC and BFFCTRL shared with NYSDOH, BFFCATD as sample is available	6 (each sample is 10 fish)	Isotopic gamma and Sr-90 in edible portions of each individual fish
Cattaraugus Creek downstream of Springville Dam **BFFCATD**					
Control Sample from nearby stream not affected by WVDP (7 km or more upstream of site effluent point) **BFFCTRL**					
Dairy Farm, 3.8 km NNW **BFMREED**	Milk from animals foraging around facility perimeter Reported: Annual Environmental Monitoring Report	Grab biological	Monthly (*BFMREED, BFMCOBO, BFMCTLS, BFMCTLN)	48 (12 per site)	Gamma isotopic, Sr-90, H-3 and I-129 on annual samples and quarterly composites of monthly samples
Dairy Farm, 1.9 km WNW **BFMCOBO**					
Dairy Farm, 3.5 km SE of site **BFMWIDR**			Annual (BFMWIDR, BFMHAUR)	2	
Dairy Farm 2.5 km SSW **BFMHAUR**					
Control location 25 km S **BFMCTLS**					
Control location 30 km N **BFMCTLN**					

*Samples shared with NYSDOH

1989 OFF-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
(3) Nearby locations **BFVNEAR**	Fruit and vegetables grown near facility perimeter downwind if possible	Grab biological	*Annually, at harvest	6	Gamma isotopic and Sr-90 analysis of edible portions, H-3 in free moisture
(3) Remote locations (16 km or more from facility) **BFVCTRL**	Reported: Annual Environmental Monitoring Report				
Beef cattle forage from near site location N **BFHNEAR**		Grab biological	Annually	2	Gamma isotopic, Sr-90
Milk cow forage from control south location or north location **BFHCTLS** or **BFHCTLN**					
Beef animal from nearby farm in downwind direction **BFBNEAR**	Meat-beef foraging near facility perimeter, downwind if possible	Grab biological	Semiannually *2nd sample (each fall) to NYSDOH	4	Gamma isotopic and Sr-90 analysis of meat
Beef animal from control location (16 km or more from facility) **BFBCTRL**	Reported: Annual Environmental Monitoring Report				
In vicinity of the site (3) **BFDNEAR**	Meat-deer foraging near facility perimeter	Individual collection biological	*Annually, during hunting season	3	Gamma isotopic and Sr-90 analysis of meat
Control animals (3) (16 km or more from facility) **BFDCTRL**	Reported: Annual Environmental Monitoring Report		*During year as available	3	

*Sample to be split with NYSDOH

1989 OFF-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Thermoluminescent Dosimetry (TLD) off-site: **DFTLD Series**	Direct radiation around facility	Integrating LiF TLD	Quarterly	460 (5 TLD's at each of 23 locations, collected 4 times per year)	Quarterly gamma radiation exposure
(16) at each of 16 compass sectors, at nearest accessible perimeter point #1-16	Reported: Monthly Environmental Monitoring Trend Analysis Annual Environmental Monitoring Report				
"5 Points" land-fill, 19 km SW (background) #17					
1500 m NW (downwind receptor) #20					
Springville 7 km N #21					
West Valley 5 km SSE #22					
Great Valley, 29 km S (background) #23					
Dunkirk, 50 km NW (background) #37					
Sardinia-Savage Rd. 24 km NE (background) #41					

1989 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Thermolumines-cent Dosimetry (TLD) on-site: ONTLD Series	Direct radiation on facility grounds	Integrating LiF TLD	Quarterly	360 (5 TLD's at each of 18 sites collected 4 times per year)	Quarterly gamma radiation exposure
(3) at corners of SDA #18, 19, 33	Reported: Monthly Environmental Monitoring Trend Analysis				
(9) at security fence around site #24, 26-34	Annual Environmental Monitoring Report				
(5) On-site near operational areas #35, 36, 38-40					
Rock Springs Road 500 m NNW of plant #25					

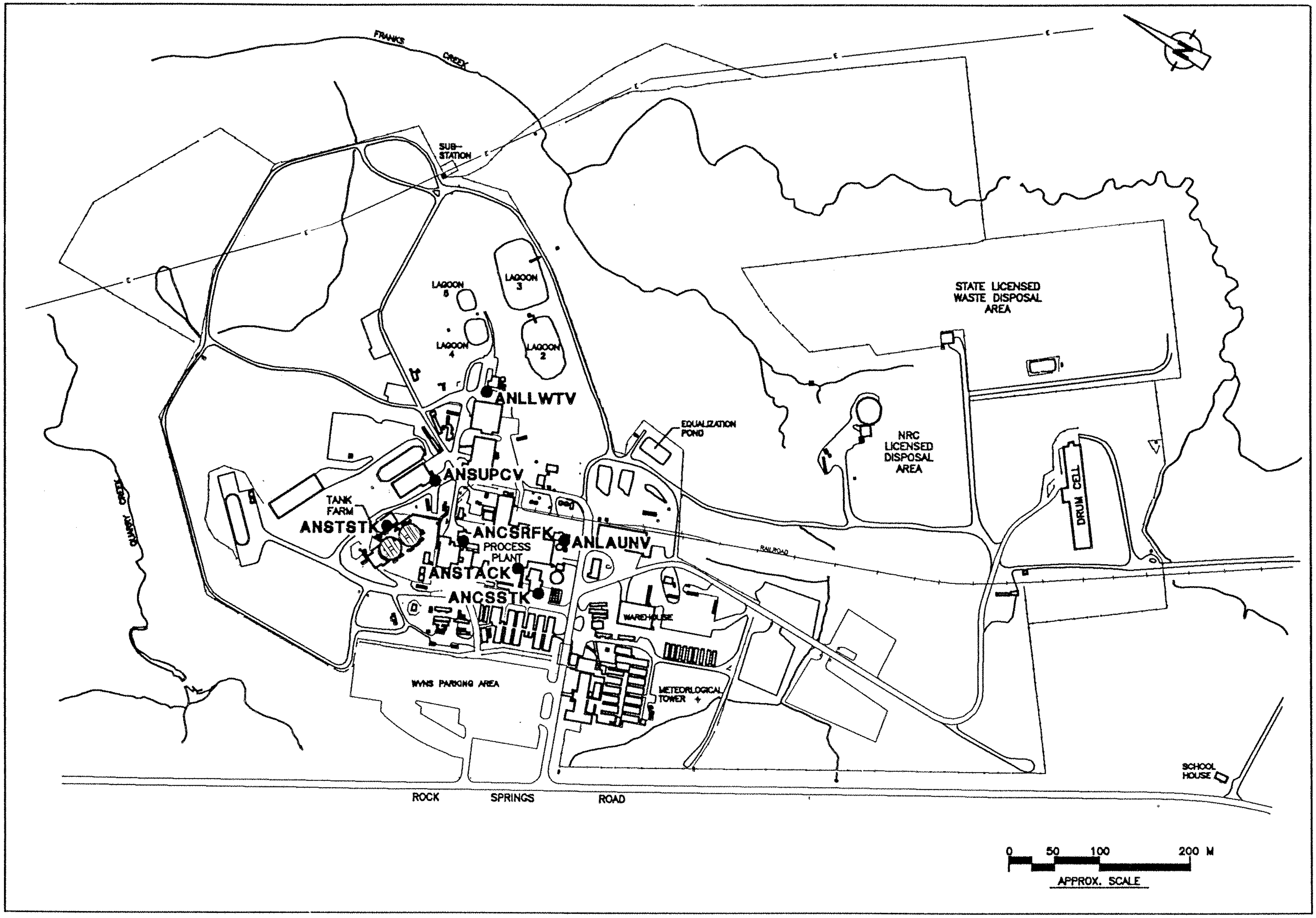


Figure A-1. Location of On-Site Air Effluent Points.

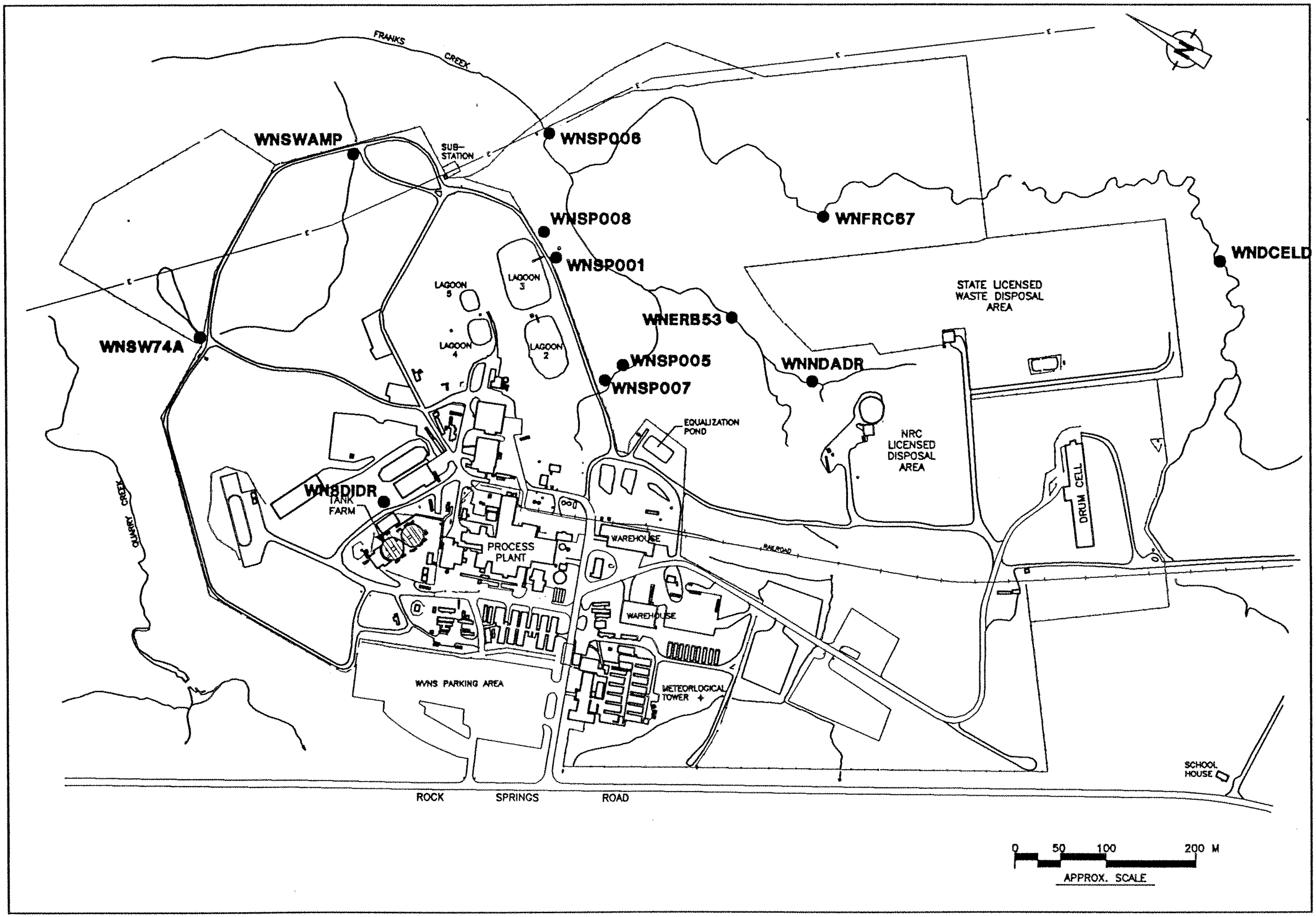


Figure A-2. Sampling Locations for On-Site Surface Water.

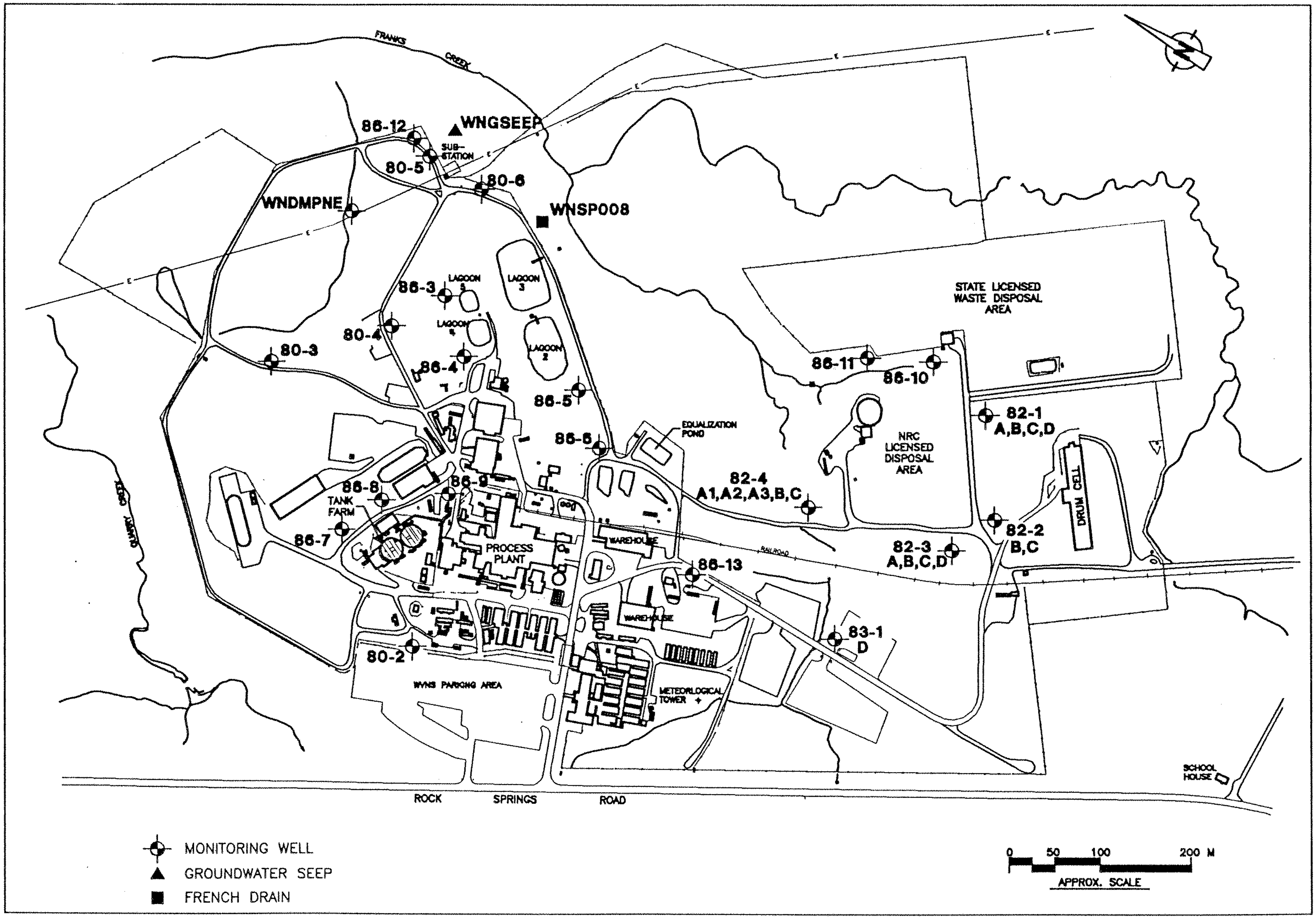


Figure A-3. Location of On-Site Groundwater Monitoring Points.

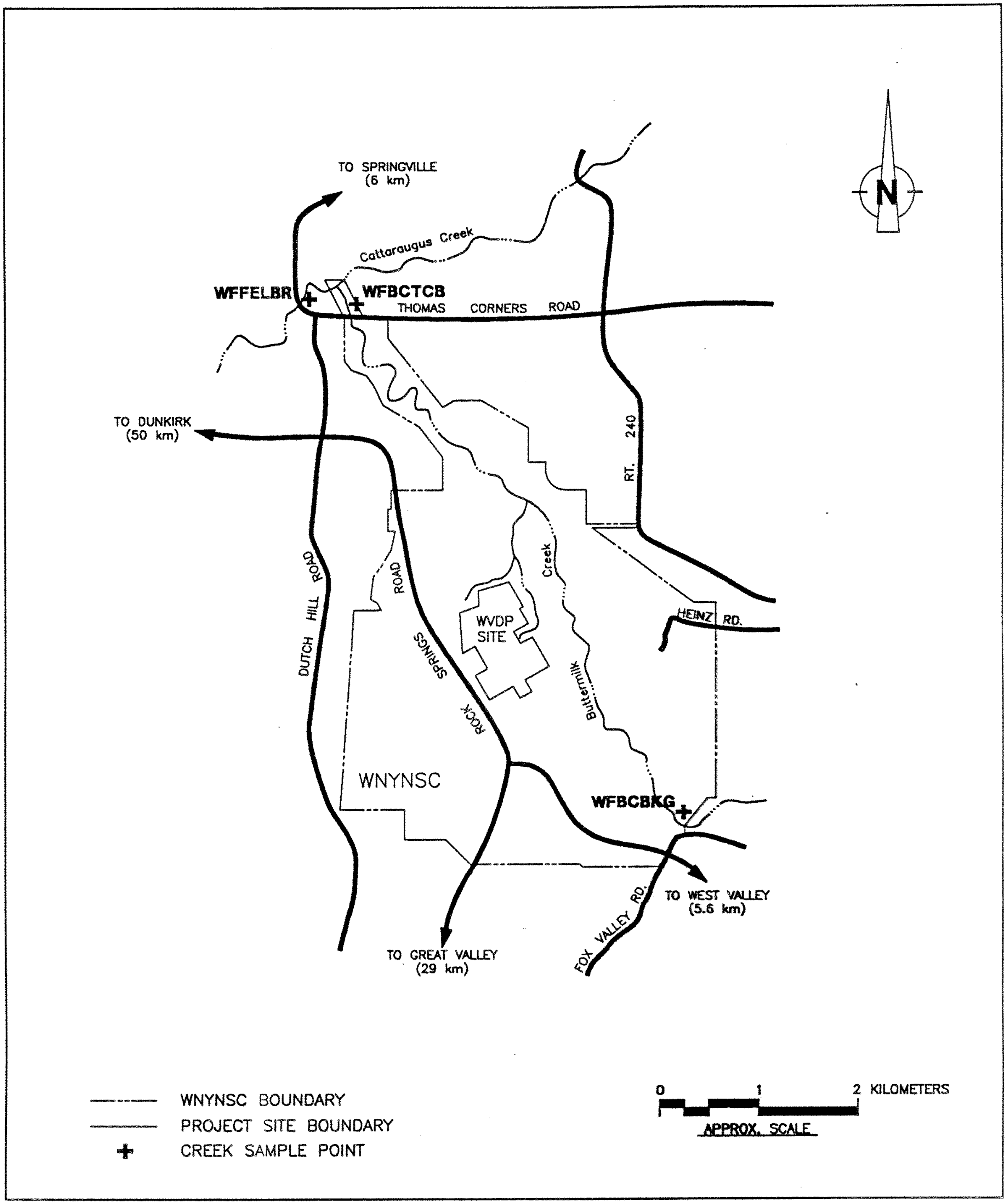


Figure A-4. Location of Off-Site Surface Water Samplers.

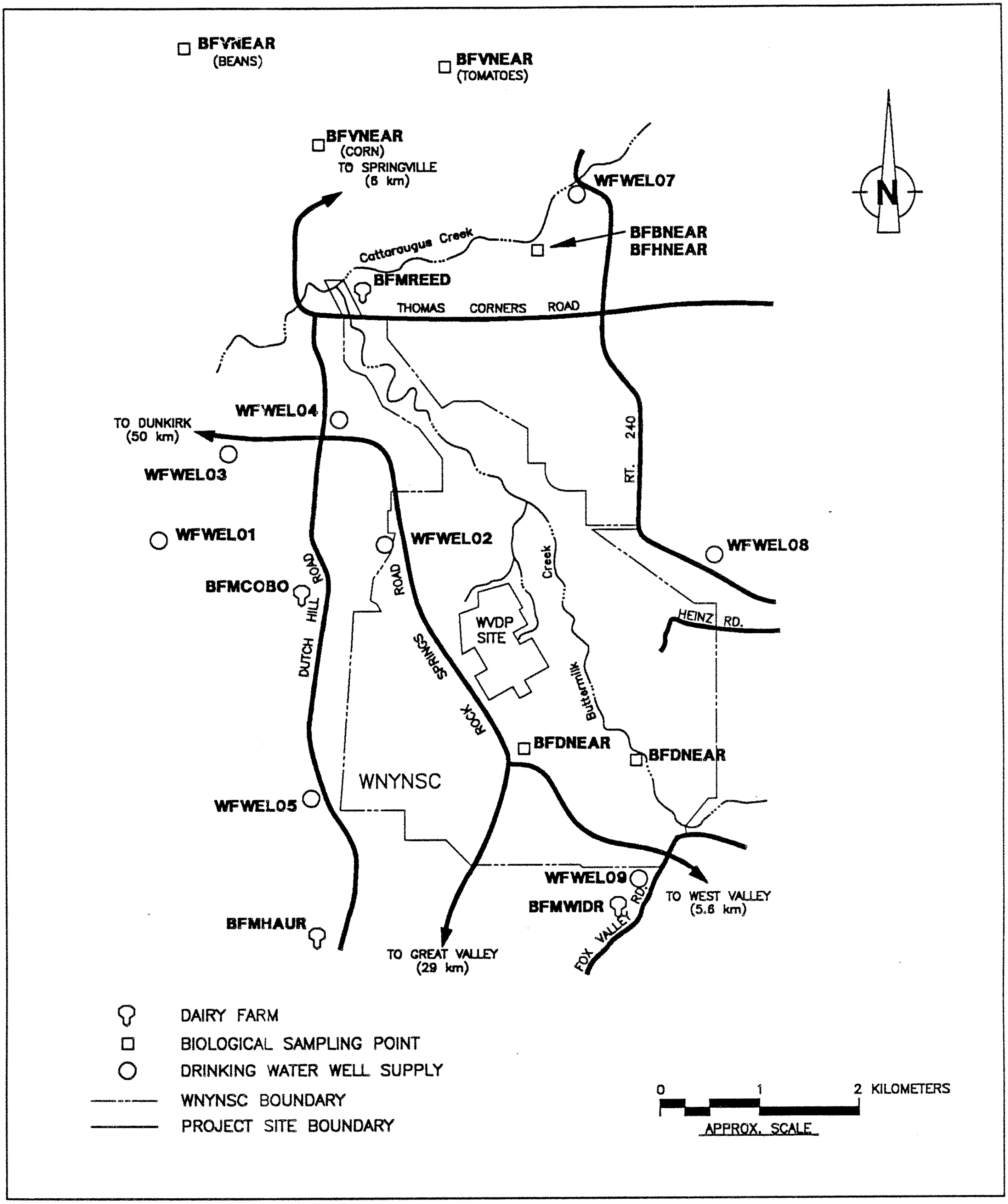


Figure A-5. Near–Site Drinking Water and Biological Sample Points – 1989.

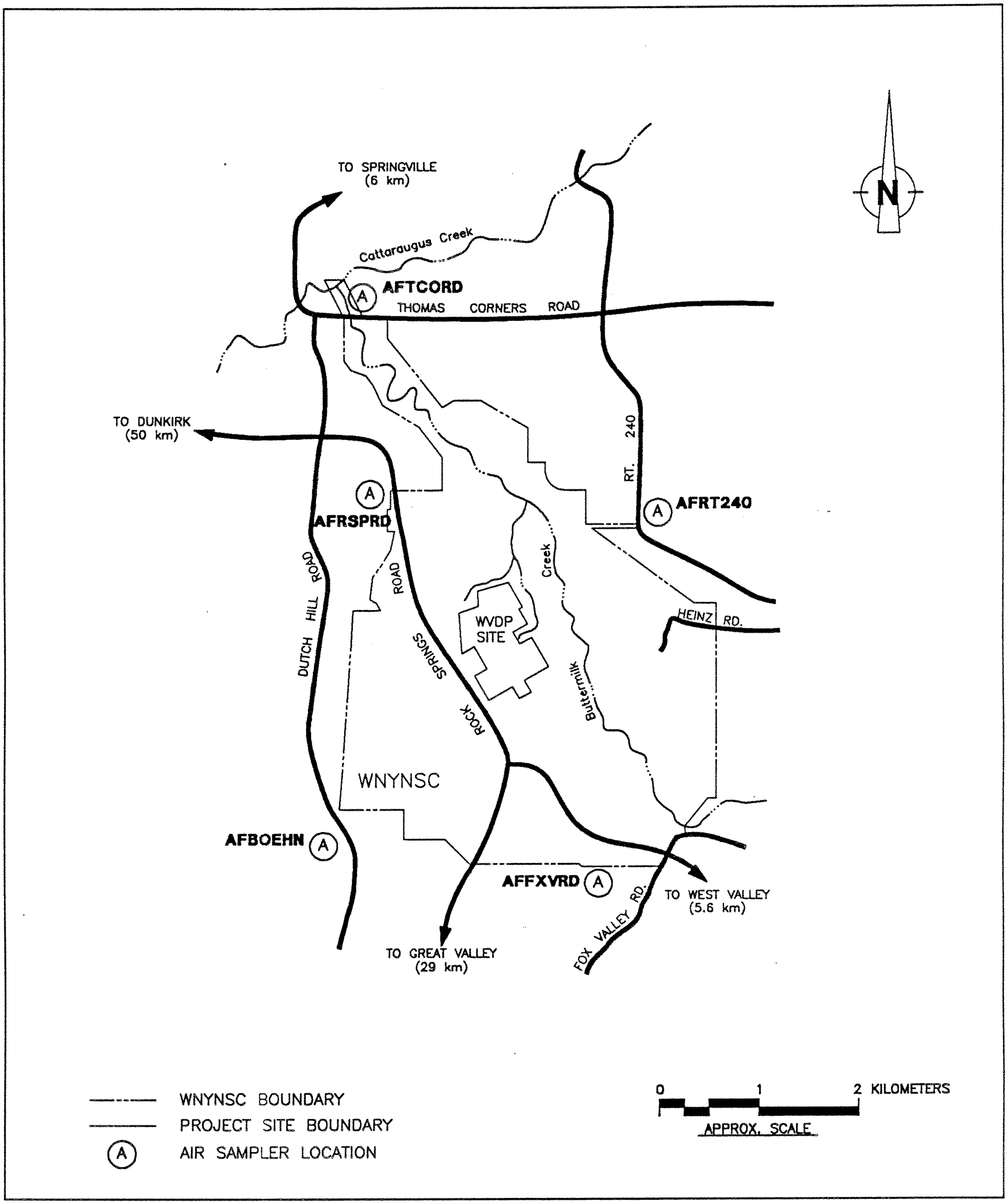


Figure A-6. Location of Perimeter Air Samplers.

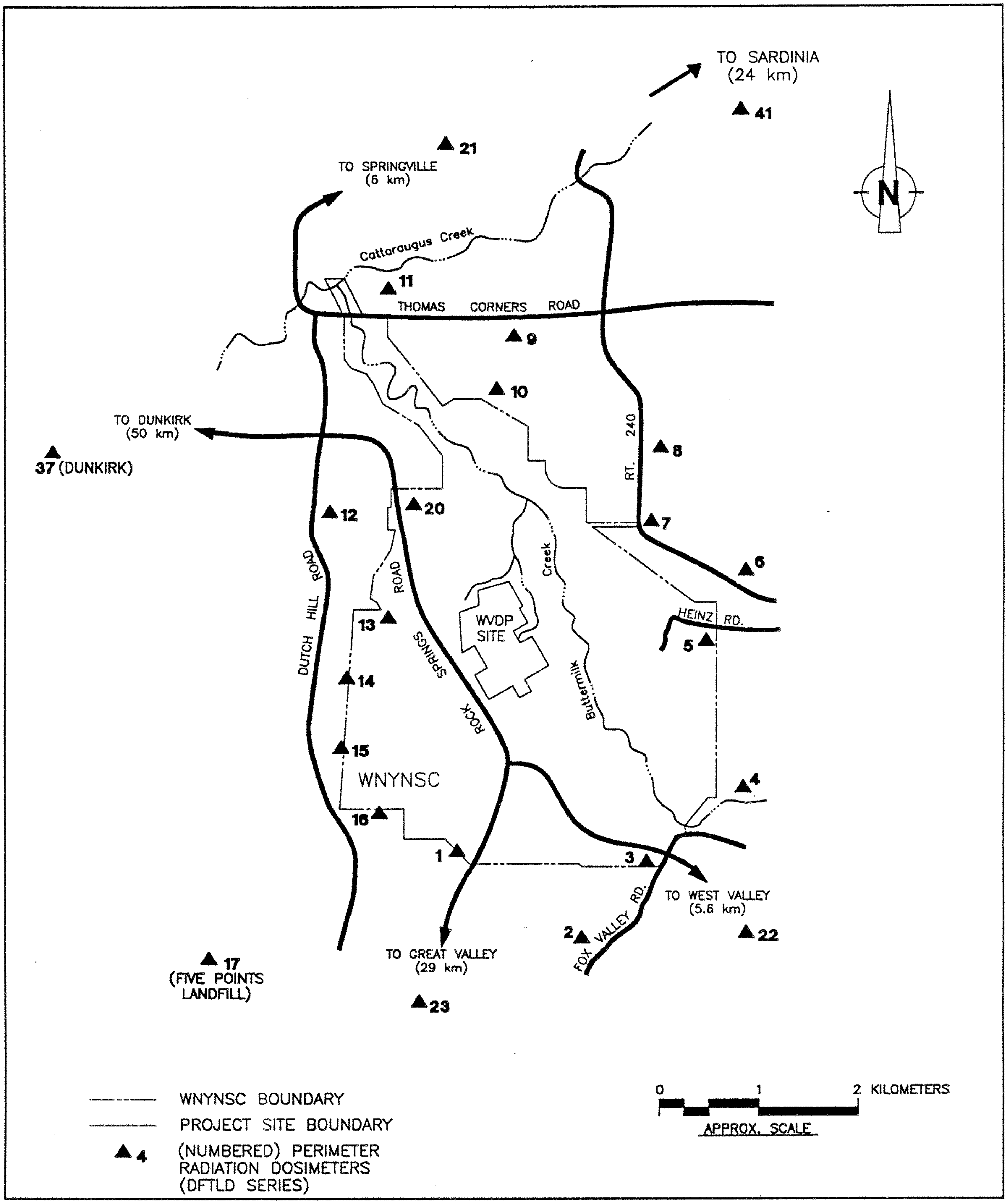


Figure A-7. Location of Off-Site Thermoluminescent Dosimetry (TLD).

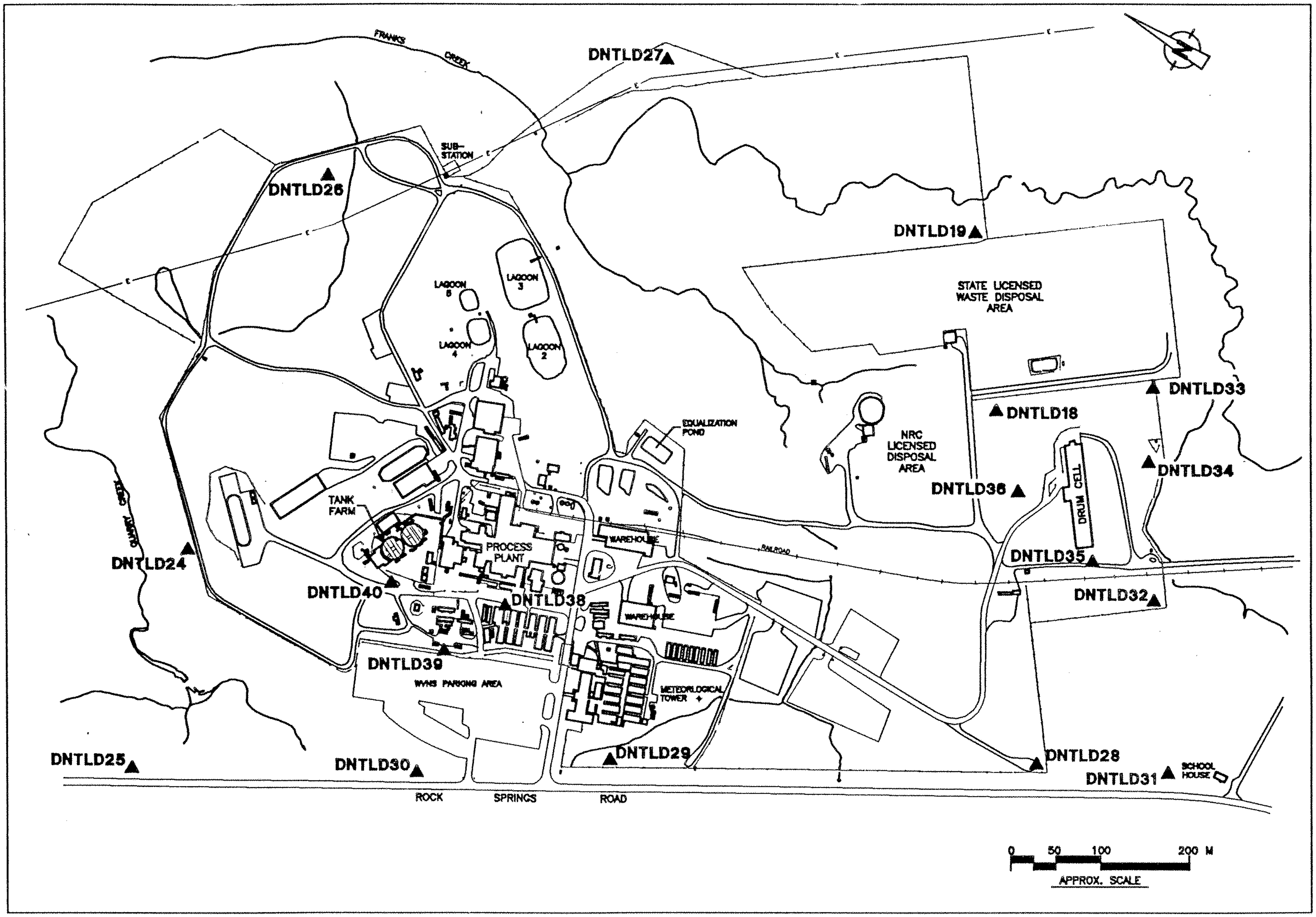
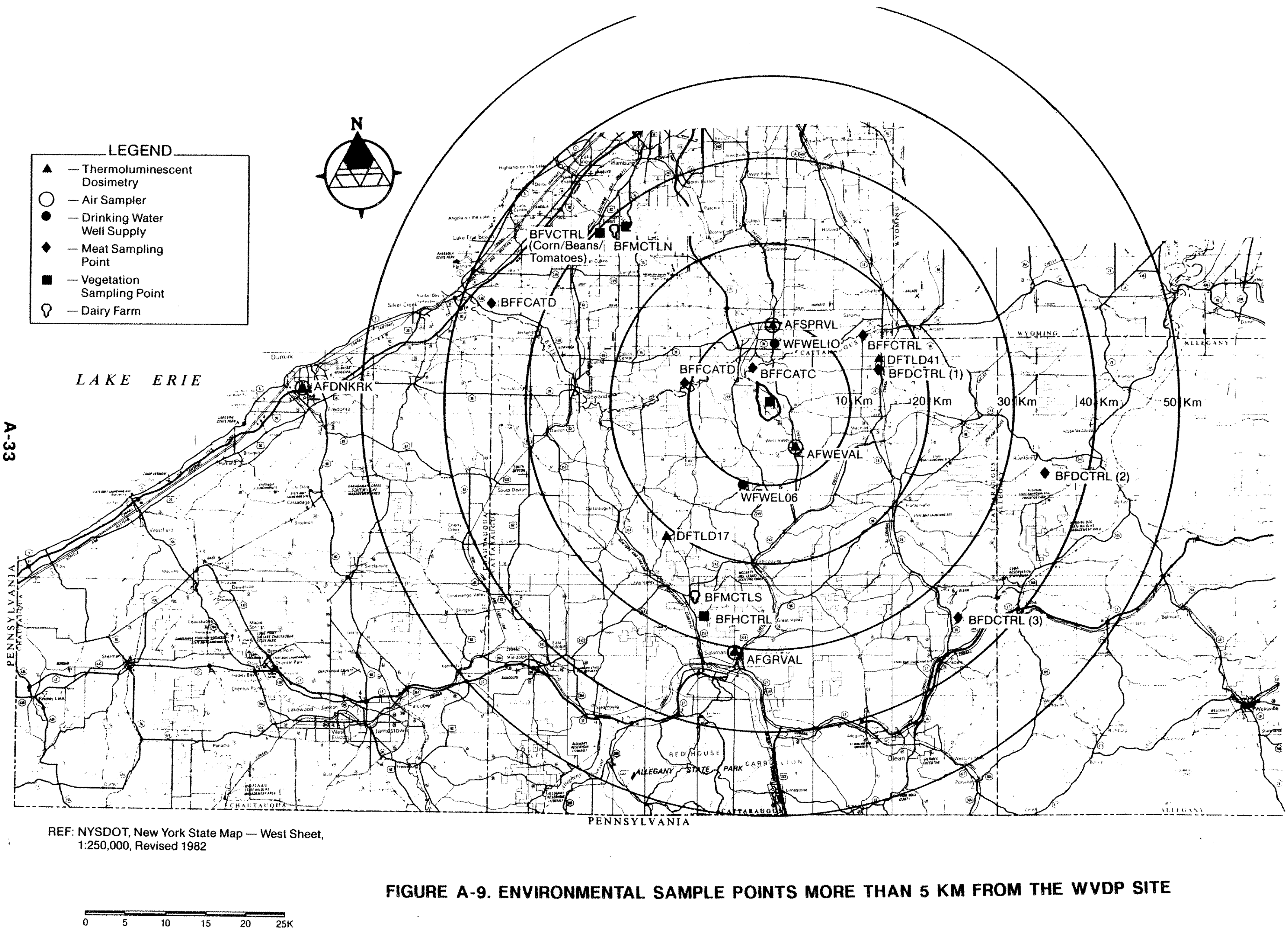


Figure A-8. Location of On-Site Thermoluminescent Dosimetry (TLD).



REF: NYSDOT, New York State Map — West Sheet, 1:250,000, Revised 1982

FIGURE A-9. ENVIRONMENTAL SAMPLE POINTS MORE THAN 5 KM FROM THE WVDP SITE

APPENDIX B

DEPARTMENT OF ENERGY RADIATION PROTECTION STANDARDS AND CONCENTRATION GUIDES

Department of Energy Radiation Protection Standards and Concentration Guides*

Effective Dose Equivalent Radiation Standard for Protection of the Public
Continuous exposure of any member of the public from routine activities:
100 mrem/year (1 mSv/year) from all exposure pathways

Department of Energy Derived Concentration Guides (DCGs) for Ingestion of Drinking Water and Inhaled Air(μCi/mL)

Radionuclide	In Air	In Water	Radionuclide	In Air	In Water
H-3	1E-07	2E-03	Eu-152	5E-11	2E-05
C-14	6E-09	7E-05	Eu-154	5E-11	2E-05
Fe-55	5E-09	2E-04	Eu-155	3E-10	1E-04
Co-60	8E-11	5E-06	Th-232	7E-15	5E-08
Ni-63	2E-09	3E-04	U-233	9E-14	5E-07
Sr-90	9E-12	1E-06	U-234	9E-14	5E-07
Zr-93	4E-11	9E-05	U-235	1E-13	6E-07
Nb-93m	4E-10	3E-04	U-236	1E-13	5E-07
Tc-99	2E-09	1E-04	U-238	1E-13	6E-07
Ru-106	3E-11	6E-06	Np-239	5E-09	5E-05
Rh-106m	6E-08	2E-04	Pu-238	3E-14	4E-08
Sb-125	1E-09	5E-05	Pu-239	2E-14	3E-08
Te-125m	2E-09	4E-05	Pu-240	2E-14	3E-08
I-129	7E-11	5E-07	Pu-241	1E-12	2E-06
Cs-134	2E-10	2E-06	Am-241	2E-14	3E-08
Cs-135	3E-09	2E-05	Am-243	2E-14	3E-08
Cs-137	4E-10	3E-06	Cm-243	3E-14	5E-08
Pm-147	3E-10	1E-04	Cm-244	4E-14	6E-08
Sm-151	4E-10	4E-04	Gross Alpha (as Am-241)	2E-14	3E-08
			Gross Beta (as Ra-228)	3E-12	1E-07

*** Ref: DOE Order 5400.5 (February 8, 1990) effective date May 8, 1990. Values are unchanged from those that were in effect in CY 1989 as transmitted by memorandum from John C. Tseng, Acting Director, Office of Environmental Guidance and Compliance, U.S. Department of Energy, November 4, 1987.**

COLLECTING A COMPOSITE WATER SAMPLE AT THE PROJECT BOUNDARY

APPENDIX C - 1

SUMMARY OF WATER AND SEDIMENT MONITORING DATA

Table C - 1 .1

Total Radioactivity of Liquid Effluents Released from WVDP Lagoon 3 in 1989(curies)

	Alpha	Beta	H-3	C-14	Sr-90	I-129	Cs-137
1st Qtr	9.02 ± 6.3 E−04	2.03 ± 0.4 E-02	1.45 ± .04 E+00	1.75 ± 0.4 E-02	1.91 ± 0.2 E-03	< 2.9 E-05	4.21 ± 2.1 E-03
2nd Qtr	1.79 ± 1.8 E−04	1.46 ± 0.2 E-02	1.46 ± .04 E+00	< 5.7E-04	1.02 ± 0.1 E-03	3.80 ± 0.9 E-05	7.18 ± 5.5 E-04
3rd Qtr	*** No release this period ***						
4th Qtr	2.11 ± 2.1 E−04	4.34 ± 0.9 E-03	9.68 ± 0.3 E-01	5.72 ± 3.4 E-04	6.48 ± 0.5 E-04	4.42 ± 1.1 E-05	5.80 ± 4.8 E-04
1989 Totals	1.29 ± 0.7 E−03	3.92 ± 0.5 E-02	3.88 ± 0.1 E+00	1.86 ± 0.4 E-02	3.58 ± 0.2 E-03	1.11 ± 0.3 E-04	5.51 ± 2.2 E-03
1989 Average (μCi/mL)	3.30 E-08	1.00 E -06	9.95E-05	4.76 E-07	9.17 E-08	2.84 E-09	1.41 E-07

	U-234	U-235	U-238	Pu-238	Pu-239	Am-241
1st Qtr	2.31 ± 0.5 E−04	7.49 ± 3.1 E-06	9.01 ± 1.2 E-05	4.28 ± 2.1 E-06	3.23 ± 0.8 E-06	1.20 ± 0.2 E-05
2nd Qtr	3.14 ± 0.5 E−05	< 2.1 E-06	1.32 ± 0.3 E-05	< 2.1 E-06	< 2.1 E-06	< 3.0 E-06
3rd Qtr	*** No release this period ***					
4th Qtr	9.63 ± 1.2 E−05	4.07 ± 1.4 E-06	2.97 ± 0.5 E-05	< 1.6 E-06	< 1.6 E-06	< 3.8 E-07
1989 Totals	3.59 ± 0.5 E−04	1.37 ± 0.4 E-05	1.33 ± 0.1 E-04	7.98 ± 3.4 E-06	6.93 ± 2.8 E-06	1.54 ± 0.4 E-05
1989 Average (μCi/mL)	9.19 E-09	3.51 E-10	3.41 E-09	2.04 E-10	1.77 E-10	3.94 E-10

Table C - 1. 2

Comparison of 1989 Lagoon 3 Liquid Effluent Radioactivity Concentrations with Department of Energy (DOE) Guidelines

Isotope	Total μCi Released[a]	Avg Concentration (μCi/mL)	DCG (μCi/L)	Percent of DCG
Alpha	1.29 E+03	3.30 E-08	N/A [b]	–
Beta	3.92 E+04	1.00 E-06	N/A [b]	–
H-3	3.88 E+06	9.95E-05	2.0 E-03	5.0
C-14	1.86 E+04	4.76 E-07	7.0 E-05	0.7
Sr-90	3.58 E+03	9.17 E-08	1.0 E-06	9.2
I-129	1.11 E+02	2.84 E-09	5.0 E-07	0.6
Cs-137	5.51 E+03	1.41 E-07	3.0 E-06	.4.7
U-234 [c]	3.59 E+02	9.19 E-09	5.0 E-07	1.8
U-235 [c]	1.37 E+01	3.51 E-10	6.0 E-07	0.1
U-238 [c]	1.33 E+02	3.41 E-09	6.0 E-07	0.6
Pu-238	7.98 E+00	2.04 E-10	4.0 E-08	0.5
Pu-239	6.93 E+00	1.77 E-10	3.0 E-08	0.6
Am-241	1.54 E+01	3.94 E-10	3.0 E-08	1.3
Total% of DCG				25.1 [d]

Notes:

[a] Total volume released = 3.90E+10 mL, measured at actual on-site release point

[b] Derived Concentration Guides (DCGs) are not applicable for gross alpha or beta activity

[c] Total U (μg) = 4.06E+08; average U (mg/L) = 1.04E-02

[d] Total percent DCG for specific measured radionuclides

Table C - 1. 3

1989 Radioactivity Concentrations in Surface Water Upstream of the WVDP at Fox Valley (WFBCBKG) (μCi/mL)

MONTH	Alpha	Beta	H-3	Sr-90	Cs-137
JAN	<7.3 E-10	2.24 ± 1.2 E−09	<1.0 E-07		
FEB	<1.0 E-09	3.10 ± 1.2 E−09	<1.0 E-07		
MAR	<7.6 E-10	5.37 ± 1.2 E−09	<1.0 E-07		
1ST QTR				<9.9E-10	<2.1E-08
APR	<5.9 E-10	1.35 ± 0.8 E−09	<1.0 E-07		
MAY	<4.0 E-10	1.95 ± 0.8 E−09	<1.0 E-07		
JUN	2.41 ± 1.4 E−09	4.73 ± 1.1 E-09	<1.0 E-07		
2ND QTR				<1.1 E-09	<2.1 E-08
JUL	1.83 ± 1.4 E−09	2.45 ± 0.9 E-09	<1.0 E-07		
AUG	<1.1 E-09	2.96 ± 1.0 E−09	<1.0 E-07		
SEP	<1.3 E-09	6.12 ± 1.3 E−09	<1.0 E-07		
3RD QTR				1.83 ± 1.3 E-09	<2.1 E-08
OCT	<9.1 E-10	4.25 ± 1.1 E−09	<1.0 E-07		
NOV	<1.1 E-09	3.21 ± 1.0 E−09	<1.0 E-07		
DEC	<7.1 E-10	1.95 ± 0.9 E−09	<1.0 E-07		
4TH QTR				5.82 ± 2.1 E−09	<2.1 E-08

Table C - 1. 4

1989 Radioactivity Concentrations in Surface Water Downstream of the WVDP at Thomas Corners (WFBCTCB) (μCi/mL)

MONTH	Alpha	Beta	H-3	Sr-90	Cs-137
JAN	<5.4 E-10	5.06 ± 1.2 E−09	2.37 ± 1.2 E-07		
FEB	<5.4 E-10	6.07 ± 1.2 E−09	<1.0 E-07		
MAR	1.29 ± 1.2 E−09	4.30 ± 1.1 E-09	<1.0 E-07		
1ST QTR				1.83 ±1.3E−09	<2.1 E-08
APR	<8.7 E-10	4.35 ±1.1E−09	<1.0 E-07		
MAY	<5.3 E-10	2.27 ± 0.9E−09	<1.0 E-07		
JUN	6.83 ± 2.9 E−09	1.62 ± 0.2E-08	5.00 ± 1.3 E-07		
2ND QTR				1.46 ± 1.3 E−09	<2.1 E-08
JUL	<8.8 E-10	3.47 ± 1.0 E−09	<1.0 E-07		
AUG	<8.2 E-10	5.55 ± 1.3 E−09	<1.0 E-07		
SEP	<2.1 E-09	7.00 ± 1.4 E−09	<1.0 E-07		
3RD QTR				4.59 ± 1.9 E−09	<2.1 E-08
OCT	<8.2 E-10	1.30 ± 0.2 E−08	1.73 ± 0.1 E-06		
NOV	<1.3 E-09	4.28 ± 1.1 E−09	<1.0 E-07		
DEC	<5.5 E-10	3.53 ± 1.0 E−09	<1.0 E-07		
4TH QTR				2.01 ± 1.5 E−09	<2.1 E-08

Table C - 1. 5

Radioactivity Concentrations in Surface Water Downstream of the WVDP at Frank's Creek (WNSPOO6)
(µCi/mL)

MONTH	Alpha	Beta	H-3
JAN	< 1.3 E-09	4.54 ± 0.4 E−08	2.34 ± 0.2 E-06
FEB	1.02 ± 1.0 E−09	1.72 ± 0.2 E-08	1.92 ± 1.2 E-07
MAR	1.82 ± 1.5 E−09	4.19 ± 0.3 E-08	4.93 ± 0.2 E-07
APR	< 9.8 E-10	2.45 ± 0.2 E−08	1.08 ± 0.1 E-06
MAY	< 8.2 E-10	1.98 ± 0.2 E−08	1.53 ± 1.1 E-07
JUN	< 1.0 E-09	1.14 ± 0.1 E−07	1.95 ± 0.1 E-05
JUL	< 1.3 E-09	4.86 ± 0.3 E−08	1.62 ± 1.2 E-07
AUG	< 1.6 E-09	5.02 ± 0.4 E−08	1.24 ± 1.1 E-07
SEP	< 1.7 E-09	4.97 ± 0.3 E−08	< 1.0 E-07
OCT	6.27 ± 3.9 E−09	9.44 ± 0.5 E-08	2.71 ± 0.1 E-05
NOV	1.80 ± 1.7 E−09	2.39 ± 0.2 E-08	1.31 ± 1.1 E-07
DEC	< 9.6 E-10	1.93 ± 0.2 E−08	1.46 ± 1.1 E-07

Table C - 1. 6

Radioactivity Concentrations in Surface Water Downstream of the WVDP at Frank's Creek (WNSPOO6)
(µCi/mL)

1989	C-14	Sr-90	I-129	Cs-137	U-234
1st Qtr	< 4.0 E-07	1.17 ± 0.2 E−08	< 2.0 E-09	3.11 ± 2.9 E-08	6.89 ± 2.8 E-10
2nd Qtr	< 5.4 E-08	1.28 ± 0.3 E−08	< 2.0 E-09	9.38 ± 3.0 E-08	5.43 ± 1.9 E-10
3rd Qtr	4.35 ± 4.2 E−08	2.18 ± 0.3 E-08	< 2.0 E-09	4.21 ± 3.0 E-08	2.92 ± 1.4 E-10
4th Qtr	< 5.8 E-08	1.82 ± 0.3 E−08	8.23 ± 4.0 E-10	3.79 ± 2.8 E-08	1.33 ± 0.3 E-09

	U-235	U-238	Pu-238	Pu-239	Am-241
1st Qtr	< 2.7 E-10	< 2.7 E-10	< 2.0 E-10	< 2.0 E-10	2.97 ± 1.1 E−10
2nd Qtr	< 2.0 E-10	3.16 ± 1.5 E−10	< 2.0 E-10	< 2.0 E-10	< 7.6 E-10
3rd Qtr	1.80 ± 1.2 E−10	2.02 ± 1.2 E-10	< 2.0 E-10	< 2.0 E-10	< 6.3 E-11
4th Qtr	< 1.1 E-10	4.37 ± 2.0 E−10	1.56 ± 0.8 E-10	1.25 ± 0.7 E-10	1.46 ± 0.9 E-10

Table C - 1. 7

Radioactivity Concentrations in Surface Water Downstream of Buttermilk Creek at Felton Bridge (WFFELBR)

(μCi/mL)

1989	Alpha	Beta	H-3	Sr-90	Cs-137
Jan	<9.6 E-10	3.87 ± 1.1 E−09	<1.2 E-07	3.53 ± 1.7 E-09	<2.1 E-08
Feb	<6.4 E-10	4.54 ± 1.1 E−09	<1.2 E-07	2.31 ± 1.3 E-09	<2.1 E-08
Mar	<9.6 E-10	5.29 ± 1.2 E−09	<1.0 E-07	2.29 ± 1.6 E-09	<2.1 E-08
Apr	1.43 ± 1.3 E−09	5.32 ± 1.2 E-09	<1.0 E-07	1.94 ± 1.3 E-09	<2.1 E-08
May	1.26 ± 1.2 E−09	4.52 ± 1.1 E-09	<1.0 E-07	2.65 ± 1.4 E-09	<2.1 E-08
Jun	2.42 ± 1.7 E−09	7.44 ± 1.4 E-09	1.22 ± 1.2 E-07	4.78 ± 1.8 E-09	<2.1 E-08
Jul	<1.2 E-09	2.57 ± 1.0 E−09	<1.0 E-07	3.49 ± 1.6 E-09	<2.1 E-08
Aug	<1.5 E-09	3.14 ± 1.1 E−09	<1.0 E-07	4.32 ± 1.8 E-09	<2.1 E-08
Sep	<8.7 E-10	3.58 ± 1.1 E−09	<1.0 E-07	2.96 ± 1.4 E-09	<2.1 E-08
Oct	<1.3 E-09	5.13 ± 1.2 E−09	1.63 ± 1.1 E-07	1.78 ± 1.2 E-09	<2.1 E-08
Nov	1.60 ± 1.5 E−09	4.47 ± 1.2 E-09	<1.0 E-07	3.25 ± 1.6 E-09	<2.1 E-08
Dec	<7.8 E-10	3.52 ± 1.1 E−09	<1.0 E-07	8.26 ± 2.3 E-09	<2.1 E-08

Table C - 1. 8

1989 Results for Potable Well Water Sampled Around the WVDP Site (μCi/mL)

Sample ID	pH	Conductivity*	Alpha	Beta	H-3	Cs-137
WFWEL01	7.68	382	<1.39E-09	3.41±1.57E-09	<1.00E-07	<3.7E-08
WFWEL02	6.85	327	<7.33E-10	1.64±1.42E-09	<1.00E-07	<3.7E-08
WFWEL03	6.86	934	<3.48E-09	4.43±2.16E-09	<1.00E-07	<3.7E-08
WFWEL04	8.00	1639	<1.64E-08	2.22±1.83E-09	<1.00E-07	<3.7E-08
WFWEL05	6.43	272	<1.01E-09	3.51±1.70E-09	<1.00E-07	<3.7E-08
WFWEL06	7.48	256	<5.55E-10	1.63±1.17E-09	<1.00E-07	<3.7E-08
WFWEL07	7.59	392	<1.11E-09	1.89 ±1.53E-09	<1.00E-07	<3.7E-08
WFWEL08	7.10	462	<1.96E-09	2.21 ±1.95E-09	<1.00E-07	<3.7E-08
WFWEL09	7.57	568	<2.09E-09	2.88±1.58E-09	<1.00E-07	<3.7E-08
WFWEL10	7.20	542	<1.14E-09	2.09±1.50E-09	<1.00E-07	<3.7E-08

* measured in μmhos/cm (@25°C)

Table C - 1. 9

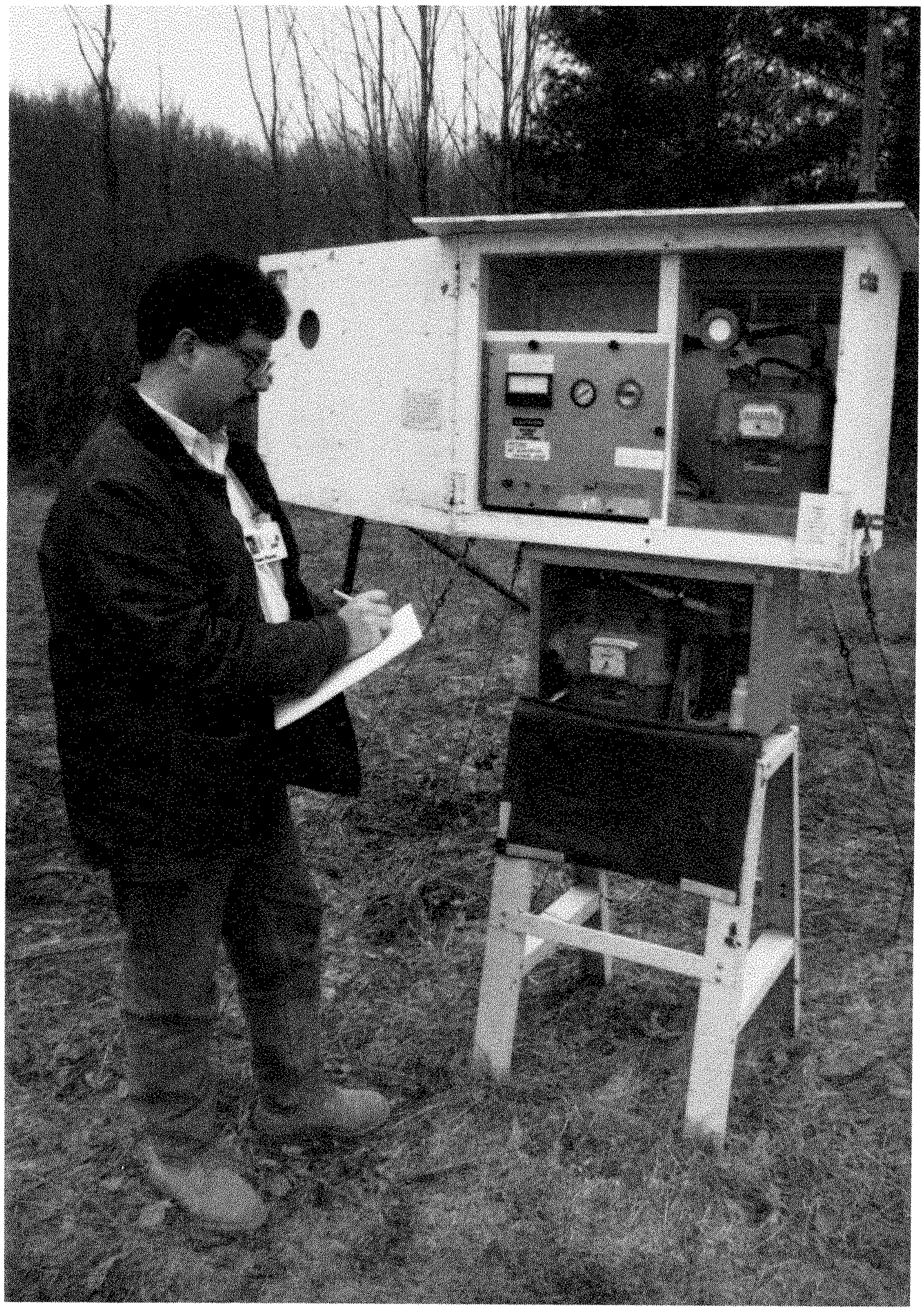
1989 Radioactivity Concentrations in Stream Sediment Around the WVDP Site (μCi/g dry weight from upper 15 cm)

Location	Date	Alpha	Beta	K-40	Cs-137	Sr-90	Co-60
SFBCSED	June 1989	1.82 ±0.96 E−05	1.57 ±0.71 E-05	1.21 ±0.13 E-05	< 1.0 E-07	1.15 ±0.47 E-07	< 7.0 E-08
SFSDSED	June 1989	2.33 ±0.94 E−05	1.95 ±0.80 E-05	1.10 ±0.13 E-05	4.74 ±1.04 E-07	9.01 ±1.05 E-07	< 7.0 E-08
SFTCSED	June 1989	4.47 ±3.76 E−06	2.37 ±0.85 E-05	9.64 ±1.22 E-06	3.31 ±0.19 E-06	7.71 ±1.01 E-07	< 7.0 E-08
SFCCSED	June 1989	1.09 ±0.67 E−05	9.73 ±6.33 E-06	1.14 ±0.15 E-05	4.14 ±0.68 E-07	< 7.2 E-08	< 7.0 E-08
SFBISED	June 1989	8.37 ±6.15 E−06	1.14 ±0.64 E-05	1.07 ±0.13 E-05	< 1.0 E-07	< 8.1 E-08	< 7.0 E-08
SFBCSED	Dec. 1989	1.74 ± 0.81E-05	6.65 ±5.82 E-06	1.17 ±0.14 E-05	< 1.0 E-07	< 7.6 E−08	< 7.0 E-08
SFSDSED	Dec. 1989	1.64±0.81E−05	1.63 ±0.72 E-05	1.23 ±0.13 E-05	2.97 ±1.20 E-07	< 8.2 E-08	< 7.0 E-08
SFTCSED	Dec. 1989	1.83 ±0.96 E−05	1.27 ±0.67 E-05	1.07 ±0.12 E-05	2.47 ±0.17 E-06	1.41±0.48 E-07	< 7.0 E-08
SFCCSED	Dec. 1989	< 8.15E-06	7.27±5.74E-06	8.64 ±1.05 E-06	2.88 ±1.04 E-07	< 6.8 E-08	< 7.0 E-08
SFBISED	Dec. 1989	1.12 ±0.80 E−05	1.57 ±0.71 E-05	1.02 ±0.11 E-05	1.14 ±0.94 E-07	1.73 ± 0.46 E-07	< 7.0 E-08
		U-234	**U-235/236**	**U-238**	**Pu-238**	**Pu-239/240**	**Am-241**
SFBCSED	June 1989	7.97 ±2.12 E−07	< 1.3 E-07	7.77 ±2.09 E-07	< 3.0 E-08	< 3.0 E-08	< 6.6 E-08
SFTCSED	June 1989	6.06 ±1.70 E−07	< 1.2 E-07	5.10 ±1.55 E-07	< 2.6 E-08	< 2.6 E-08	< 8.6 E-08

Table C - 1. 10

1989 Contribution by New York State Low-Level Waste Disposal Area to Radioactivity in WVDP Liquid Effluents (curies)

	TOTALS
Gross Alpha	< 8.4 E-07
Gross Beta	1.51 ± .04E −03
H-3	6.74 ± 0.2 E−02
C-14	8.53 ± 1.7 E−05
Sr-90	7.08 ± 0.1 E−04
I-129	1.15 ± 0.3 E−06
Cs-137	< 9.0 E-06
U-234	1.96 ± 0.8 E−07
U-235	< 8.5 E-08
U-238	1.23 ± 0.6 E−07
Pu-238	< 8.5 E-08
Pu-239	< 8.5 E-08
Am-241	< 2.3 E-07



WEEKLY VISIT TO A PERIMETER AIR SAMPLER

APPENDIX C - 2

SUMMARY OF AIR MONITORING DATA

Table C - 2. 1.

1989 Airborne Radioactive Effluent Activity Monthly Totals (curies) from Main Ventilation Stack (ANSTACK)

MONTH	Alpha	Beta	Tritium
JAN	3.61 ±1.1 E-07	1.45 ±0.1 E-05	2.42 ±0.2 E-02
FEB	9.45 ±5.4 E-08	3.30 ±0.3 E-06	2.36 ±0.2 E-02
MAR	1.20 ±0.7 E-07	9.00 ±0.5 E-06	3.20 ±0.3 E-02
APR	2.77 ±0.9 E-07	1.58 ±0.1 E-05	2.31 ±0.2 E-02
MAY	1.19 ±0.6 E-07	1.31 ±0.1 E-05	1.54 ±0.2 E-02
JUN	2.04 ±0.7 E-07	4.31 ±0.1 E-05	2.02 ±0.2 E-02
JUL	2.10 ±0.9 E-07	1.05 ±0.1 E-05	3.02 ±0.3 E-02
AUG	1.16 ±0.6 E-07	1.15 ±0.1 E-05	2.17 ±0.2 E-02
SEP	1.35 ±0.6 E-07	9.86 ±0.6 E-06	2.46 ±0.3 E-02
OCT	2.10 ±0.8 E-07	1.35 ±0.1 E-05	2.27 ±0.2 E-02
NOV	1.68 ±0.7 E-07	9.64 ±0.7 E-06	1.29 ±0.1 E-02
DEC	1.61 ±0.8 E-07	6.18 ±0.4 E-06	1.94 ±0.2 E-02
1989 TOTALS	2.18 ±0.3 E-06	1.60 ± -0.03E-04	2.70 ±0.1 E-01

Table C - 2. 2

1989 Airborne Radioactive Effluent Activity Quarterly Totals (curies)from Main Ventilation Stack (ANSTACK)

	C0-60	SR-90	I-129	CS-134	CS-137	EU-154
1ST QTR	<4.0 E-07	7.23 ±0.7 E-06	1.05 ±0.1 E-05	<9.3 E-08	7.42 ±0.8 E-06	<1.1 E-07
2ND QTR	<1.4 E-07	2.56 ±0.3 E-05	1.60 ±0.1 E-05	<9.2 E-08	2.01 ±0.2 E-05	<1.3 E-07
3RD QTR	6.37 ±4.1 E-08	1.20 ±0.1 E-05	1.82 ±0.1 E-05	<7.4 E-08	1.04 ±0.1 E-05	<1.1 E-07
4TH QTR	5.58 ±4.1 E-08	4.40 ±0.4 E−06	1.12 ±0.1 E-05	<8.4 E-08	9.95 ±1.0 E-06	<1.2 E-07
1989 TOTALS	<4.3 E-07	4.92 ±0.3 E-05	5.59 ±0.2 E-05	<1.7 E-07	4.79 ±0.3 E-05	<2.4 E-07

	U-234	U-235	U-238	PU-238	PU-239	AM-241
1ST QTR	6.98 ±3.7 E-09	<4.3 E-09	6.98 ±3.7 E-09	6.70 ±0.9 E-08	8.91 ±1.2 E-08	3.88 ±0.6 E-07
2ND QTR	<4.8 E-09	<4.8 E-09	<4.8 E-09	1.46 ±0.3 E-07	1.40 ±0.3 E-07	1.57 ±1.3 E-08
3RD QTR	9.00 ±5.6 E-09	<7.2 E-09	9.00 ±5.6 E-09	6.77 ±1.4 E-09	9.09 ±1.8 E-09	2.22 ±1.5 E-09
4TH QTR	1.06 ±0.4 E-08	<3.3 E-09	2.14 ±0.5 E-08	6.67 ±1.3 E-08	8.35 ±1.6 E-08	<3.5 E-09
1989 TOTALS	3.14 ±1.2 E-08	<1.0 E-08	3.74 ±1.0 E-08	2.86 ±0.3 E-07	3.22 ±0.4 E-07	4.09 ±0.6 E-07

Table C - 2. 3

Comparison of 1989 Main Stack Exhaust Radioactivity Concentrations with Department of Energy Guidelines

ISOTOPE	Half-life	Total μCi Released [a]	Avg Conc (μCi/mL)	DCG(μCi/mL)	Percent Of DCG[c]
ALPHA	N/A	2.18E+00 (7.99E+04 Bq)	2.4 E-15	NA [b]	—
BETA	N/A	1.60E+02 (5.88E+06 Bq)	1.8 E-13	NA [b]	—
H-3	12.35 years	2.70E+05(9.99E+09 Bq)	3.0E-10[d]	1 E-07	0.3
Co-60	5.27 years	<4.3E-01(<1.59E+04Bq)	<4.8 E-16	8 E-11	<0.1
Sr-90	29.124 years	4.92E+01 (1.82E+06 Bq)	5.5 E-14	9 E-12	0.6
I-129	1.57E+07 years	5.59E+01 (2.07E+06 Bq)	6.3 E-14	7 E-11	<0.1
Cs-134	2.06 years	<1.7E-01(<6.29E+03 Bq)	<1.9 E-16	2 E-10	<0.1
Cs-137	30 years	4.79E+01(1.77E+06 Bq)	5.4 E-14	4 E-10	<0.1
Eu-154	8.8 years	<2.4E-01(<8.88E+03 Bq)	<2.7 E-16	5 E-11	<0.1
U-234 [e]	2.45 E+05 years	3.14E-02(9.84E+02 Bq)	3.5 E-17	9 E-14	<0.1
U-235 [e]	7.1 E+08 years	<1.0E-02(<3.7E+02 Bq)	<1.1 E-17	1 E-13	<0.1
U-238 [e]	4.47 E+09 years	3.74E-02(1.38E+03 Bq)	4.2 E-17	1 E-13	<0.1
Pu-238	87.07 years	2.86E-01(1.06E+04 Bq)	3.2 E-16	3 E-14	1.1
Pu-239	2.4 E+04 years	3.22E-01(1.19E+04 Bq)	3.6 E-16	2 E-14	1.8
Am-241	432 years	4.09E-01(1.50E+04 Bq)	4.6 E-16	2 E-14	2.3
					6.4 [c]

NOTES:

[a] Total volume released at 60,000 cfm = 8.92 E+14 mL/year. μCi values are expressed also in Bq

[b] Derived Concentration Guides (DCG) are not specified for gross alpha or gross beta activity

[c] Total percent DCG for applicable measured radionuclides. The percent DCG at the site boundary location with the highest annual average concentration is only 0.000027

[d] Tritium reported in pCi/mL = 3.0E-04

[e] Total U(μg) = 1.36E+05; average U(pg/mL) = 1.52E-04

DCGs are listed for reference only. They are applicable to the average concentrations at the site boundary but not to the stack concentrations, as might be inferred from their inclusion in this table.

Table C - 2. 4

1989 Airborne Radioactive Effluent Activity Monthly Totals (curies)from Cement Solidification System Ventilation Stack (ANCSSTK)

MONTH	Alpha	Beta
JAN	<5.0E-09	6.18 ±2.1 E-08
FEB	<4.6E-09	6.69 ±2.1 E-08
MAR	<7.2E-09	6.56 ±2.4 E-08
APR	<5.7E-09	6.99 ±2.4 E-08
MAY	<4.7E-09	4.82 ±1.8 E-08
JUN	<5.6E-09	6.66 ±2.1 E-08
JUL	<5.1E-09	7.65 ±2.6 E-08
AUG	<5.6E-09	3.82 ±1.7 E-08
SEP	<6.1E-09	3.19 ±1.9 E-08
OCT	<6.2E-09	2.48 ±1.5 E-08
NOV	<4.2E-09	2.42 ±1.5 E-08
DEC	<5.3E-09	1.68 ±1.6 E-08
1989 TOTALS	<1.9E-08	5.91 ±0.7 E-07

Table C - 2. 5

1989 Airborne Radioactive Effluent Activity Quarterly Totals (curies)from Cement Solidification System Ventilation Stack (ANCSSTK)

	C0-60	SR-90	I-129	CS-134	CS-137	EU-154
1ST QTR	<4.3 E-08	1.13 ±0..7 E-09	<1.5 E-08	<1.8 E-08	<2.0 E-08	<1.8 E-08
2ND QTR	<2.2 E-08	4.44 ±.2.1 E-09	5.24 ±1.0 E-08	<1.4 E-08	<1.8 E-08	<1.2 E-08
3RD QTR	<4.6 E-08	3.20 ±0.7 E-09	7.31 ±1.2 E-08	<3.7 E-08	<3.8 E-08	<3.1 E-08
4TH QTR	<1.6 E-08	3.84 ±0.7 E-09	8.25 ±1.3 E-08	<9.4 E-09	<1.3 E-08	<1.5 E-08
1989 TOTALS	<6.9 E-08	1.26 ±0.2 E-08	2.23 ±0.3 E-07	<4.4 E-08	<4.8 E-08	<4.1 E-08

	U-234	U-235	U-238	PU-238	PU-239	AM-241
1ST QTR	1.78±0.8 E−09	<8.5 E-10	1.84 ±0.8 E-09	<1.4 E-10	<2.0 E-10	2.44 ±1.0 E−09
2ND QTR	<2.5 E-09	<2.5 E-09	<2.5 E-09	<1.3 E-09	<2.3 E-09	<3.0 E-10
3RD QTR	<2.1 E-09	<2.1 E-09	<2.1 E-09	<3.2 E-11	<3.2 E-11	3.67 ±2.8 E-10
4TH QTR	1.37 ±0.7 E-09	<8.0 E-10	<8.0 E-10	<2.4 E-10	3.91 ±3.6 E-10	<1.4 E-09
1989 TOTALS	<3.4 E-09	<3.5 E-09	<3.5E-09	<1.3 E-09	<2.3 E-09	4.51 ±1.8 E-09

Table C - 2. 6.

1989 Airborne Radioactive Effluent Activity Monthly Totals (curies) from the Contact Size Reduction Facility Ventilation Stack (ANCSRFK)

MONTH	Alpha	Beta
JAN	< 3.9E-09	5.76 ±1.4 E-08
FEB	< 2.8E-09	4.59 ±1.3 E-08
MAR	< 4.2E-09	4.66 ±1.4 E-08
APR	< 3.7E-09	4.74 ±1.5 E-08
MAY	< 2.3E-09	3.31 ±1.1 E-08
JUN	< 2.7E-09	4.14 ±1.2 E-08
JUL	< 3.8E-09	2.17 ±1.1 E-08
AUG	< 3.3E-09	2.42 ±1.0 E-08
SEP	< 2.9E-09	1.76 ±1.0 E-08
OCT	< 2.9E-09	1.12 ±0.8 E-08
NOV	< 2.8E-09	1.00 ±0.8 E-08
DEC	< 3.3E-09	1.33 ±0.9 E-08
1989 TOTALS	< 1.1E-08	3.70 ±0.4 E-07

Table C - 2. 7

1989 Airborne Radioactive Effluent Activity Quarterly Totals (curies) from Contact Size Reduction Facility Ventilation Stack (ANCSRFK)

	C0-60	SR-90	I-129	CS-134	CS-137	EU-154
1ST QTR	< 2.7 E-08	2.60 ±0.5 E-09	< 8.0 E-09	< 1.1 E-08	< 1.5 E-08	< 1.1 E-08
2ND QTR	< 1.3 E-08	< 1.8 E-09	1.03 ±0.1 E-07	< 7.4 E-09	< 8.2 E-09	< 9.0 E-09
3RD QTR	< 1.2 E-08	7.08 ±3.7 E-10	< 7.1 E-09	< 7.4 E-09	< 7.9 E-09	< 7.4 E-09
4TH QTR	< 1.3 E-08	3.85 ±0.6 E-09	< 6.5 E-09	< 7.4 E-09	< 7.1 E-09	< 7.9 E-09
1989 TOTALS	< 3.5 E-08	8.96 ±2.0 E-09	1.25 ±0.2 E-07	< 1.7 E-08	< 2.0 E-08	< 1.8 E-08

	U-234	U-235	U-238	PU-238	PU-239	AM-241
1ST QTR	7.87 ±4.0 E-10	< 4.6 E-10	8.89 ±4.2 E-10	5.07 ±4.6 E-11	6.08 ±5.0 E-11	< 1.3 E-09
2ND QTR	< 1.4 E-09	< 1.4 E-09	< 1.4 E-09	< 2.8 E-10	< 2.8 E-10	1.06 ±0.6 E-09
3RD QTR	< 7.6 E-10	< 7.6 E-10	9.23 ±6.0 E-10	< 1.6 E-11	< 2.1 E-11	2.09 ±1.7 E-10
4TH QTR	< 6.5 E-10	< 6.5 E-10	< 6.5 E-10	2.77 ±2.1 E-10	< 1.2 E-10	< 2.2 E-10
1989 TOTALS	< 1.8 E-09	< 1.8 E-09	3.82 ±1.7 E-09	6.24 ±3.5 E-10	< 3.1 E-10	2.79±1.5 E-09

Table C - 2. 8

1989 Airborne Radioactive Effluent Activity Monthly Totals (curies) from the Supernatant Treatment System Ventilation Stack (ANSTSTK)

MONTH	Alpha	Beta
JAN	<1.7E-09	1.54 ±0.6 E-08
FEB	<2.1E-09	2.27 ±0.7 E-08
MAR	<2.2E-09	2.48 ±0.8 E-08
APR	<2.1E-09	2.63 ±0.9 E-08
MAY	<1.6E-09	1.89 ±0.7 E-08
JUN	<1.5E-09	1.88 ±0.7 E-08
JUL	<1.9E-09	1.34 ±0.8 E-08
AUG	<1.5E-09	9.81 ±5.6 E-09
SEP	<2.0E-09	1.11 ±0.7 E-08
OCT	<1.6E-09	1.10 ±0.6 E-08
NOV	<1.5E-09	1.42 ±0.6 E-08
DEC	<1.7E-09	9.44 ±6.0 E-09
1989 TOTALS	<6.2E-09	1.96±0.2 E-07

Table C - 2. 9

1989 Airborne Radioactive Effluent Activity Quarterly Totals (curies)from the Supernatant Treatment System Ventilation System (ANSTSTK)

	C0-60	SR-90	I-129	CS-134	CS-137	EU-154	H-3
1ST QTR	<2.1 E-08	5.33 ±3.0 E-10	2.34 ±0.2 E-07	<8.3 E-09	<9.8 E-09	<8.3 E-09	ND
2ND QTR	<8.9 E-09	<2.2 E-09	2.93 ±0.2 E-07	<7.0 E-09	<7.0 E-09	<5.9 E-09	ND
3RD QTR	<8.6 E-09	1.93 ±0.3 E-09	2.34 ±0.2 E-07	<4.5 E-09	<5.6 E-09	<4.8 E-09	ND
4TH QTR	<9.1 E-09	1.34 ±0.3 E-09	6.20 ±0.4 E-07	<5.3 E-09	<4.9 E-09	<6.2 E-09	ND
1989 TOTALS	<2.6 E-08	6.00 ±2.3 E-09	1.38 ±0.1 E-06	<1.3 E-08	<1.4 E-08	<1.3 E-08	ND

	U-234	U-235	U-238	PU-238	PU-239	AM-241
1ST QTR	8.24 ±3.5 E-10	<3.6 E-10	1.04 ±0.4 E-09	<6.2 E-11	<8.9 E-11	1.10 ±0.4 E-09
2ND QTR	<1.2 E-09	<1.2 E-09	<1.2 E-09	<3.8 E-10	4.50 ±4.1 E-10	<2.8 E-10
3RD QTR	7.43 ±5.0 E-10	<6.6 E-10	1.09 ±0.6 E-09	<1.8 E-11	<1.3 E-11	<1.5 E-10
4TH QTR	7.83 ±3.6 E-10	<3.8 E-10	<3.8 E-10	2.03 ±1.7 E-10	<2.5 E-10	<2.0 E-10
1989 TOTALS	3.55 ±1.4 E-09	<1.5 E-09	3.71 ±1.5 E-09	<4.2 E-10	<4.9 E-10	1.73 ±0.5 E-09

ND - No discharge detectable. No moisture could be collected for H-3 analysis because of dry exhaust air conditons.

Table C - 2. 10

1989 Airborne Radioactive Effluent Activity Monthly Totals (curies)from (ANSUPCV) Supercompactor Ventilation System

MONTH	Alpha	Beta
JAN	< 1.0E-10	1.02 ±0.4 E-09
FEB	2.26 ±1.6 E-10	1.51 ±0.3 E-09
MAR	< 2.0E-10	2.65 ±0.6 E-09
APR	< 1.0E-10	2.01 ±0.6 E-09
MAY	< 1.7E-10	3.71 ±0.6 E-09
JUN	< 1.1E-10	2.13 ±0.5 E-09
JUL	< 1.4E-10	2.74 ±0.6 E-09
AUG	< 1.1E-10	2.52 ±0.6 E-09
SEP	3.61 ±2.4 E-10	4.61 ±0.7 E-09
OCT	< 1.3E-10	2.03 ±0.5 E-09
NOV	< 1.5E-10	1.88 ±0.5 E-09
DEC	2.91 ±2.4 E-10	5.25 ±0.6 E-09
1989 TOTALS	2.09±0.6 E-09	3.24 ±0.2 E-08

Table C - 2. 11

1989 Airborne Radioactive Effluent Activity Quarterly Totals (curies)from (ANSUPCV) Supercompactor Ventilation System

	C0-60	SR-90	CS-134	CS-137	EU-154	
1ST QTR	< 5.0 E-09	< 1.1 E-10	< 1.9 E-09	1.78 ±1.2 E-09	< 1.7 E-09	
2ND QTR	< 1.6 E-09	< 3.3 E-10	< 1.2 E-09	1.60 ±0.8 E-09	< 1.0 E-09	
3RD QTR	< 1.7 E-09	2.05 ±0.7 E-10	< 1.4 E-09	< 1.8 E-09	< 1.2 E-09	
4TH QTR	< 2.5 E-09	1.74±0.7 E-10	< 1.1 E-09	2.73 ±1.0 E-09	< 1.4 E-09	
1989 TOTALS	< 6.1 E-09	8.19 ±3.6 E-10	< 2.9 E-09	7.91 ±2.5 E-09	< 2.7 E-09	
	U-234	**U-235**	**U-238**	**PU-238**	**PU-239**	**AM-241**
1ST QTR	1.05 ±0.6 E-10	< 6.7 E-11	< 6.7 E-11	< 4.7 E-12	7.60 ±6.8 E-12	4.38 ±2.0 E-10
2ND QTR	< 1.6 E-10	< 1.6 E-10	< 1.6 E-10	< 9.0 E-11	< 4.7 E-11	< 2.8 E-11
3RD QTR	4.60 ±1.2 E-10	8.21 ±5.6 E-11	3.29 ±1.0 E-10	< 3.2 E-12	< 3.2 E-12	< 1.9 E-11
4TH QTR	< 1.5 E-10	< 1.5 E-10	< 1.5 E-10	< 2.9 E-11	< 2.9 E-11	< 4.7 E-11
1989 TOTALS	8.75 ±2.6 E-10	< 2.4 E-10	7.06 ±2.5 E-10	< 9.5 E-11	< 5.6 E-11	5.32±2.1 E-10

Table C - 2. 12

1989 Radioactivity Concentrations in Airborne Particulates at Fox Valley Air Sampler (AFFXVRD)(μCi/mL)

Month	Alpha	Beta	Strontium-90	Cesium-137
JAN	8.26 ±7.3 E-16	2.66 ±0.3 E-14		
FEB	1.14 ±0.8 E-15	2.40 ±0.3 E-14		
MAR	1.07 ±0.8 E-15	2.11 ±0.3 E-14		
1st Qtr			< 7.96 E-17	< 7.40 E-16
APR	9.82 ±7.6 E-16	2.01 ±0.3 E-14		
MAY	< 5.85 E-16	1.47 ±0.3 E-14		
JUN	8.44 ±6.9 E-16	1.52 ±0.3 E−14		
2nd Qtr			< 2.03 E-16	< 6.89 E-16
JUL	1.38 ±0.9 E-15	1.67 ±0.3 E-14		
AUG	9.21 ±7.3 E-16	1.74 ±0.3 E-14		
SEP	< 5.78 E-16	1.51 ±0.3 E-14		
3rd Qtr			4.77±2.4 E-17	< 4.49 E-16
OCT	8.94 ±6.9 E-16	2.14 ±0.3 E-14		
NOV	1.46 ±1.1 E-15	2.52 ±0.4 E-14		
DEC	2.12 ±1.2 E-15	1.09 ±0.4 E-14		
4th Qtr			< 5.14 E-17	< 4.75 E-16

Table C - 2. 13

1989 Radioactivity Concentrations in Airborne Particulates at Rock Springs Rd. Sampler (AFRSPRD)(μCi/mL)

Month	Alpha	Beta	Strontium-90	Iodine-129	Cesium-137
JAN	1.11 ±0.8 E-15	2.97 ±0.4 E-14			
FEB	1.26 ±0.8 E-15	2.82 ±0.4 E-14			
MAR	1.22 ±0.9 E-15	2.30 ±0.3 E-14			
1st Qtr			< 5.30 E-17	< 3.81 E-16	< 7.43 E-16
APR	9.44 ±7.7E-16	1.87 ±0.3 E-14			
MAY	5.88 ±5.4 E-16	1.49 ±0.3 E-14			
JUN	5.25 ±5.1 E-16	1.47 ±0.3 E-14			
2nd Qtr			< 1.27 E-16	< 3.40 E-16	< 6.71 E-16
JUL	1.19 ±0.8 E-15	1.66 ±0.3 E-14			
AUG	9.52 ±6.8 E-16	1.80 ±0.3 E-14			
SEP	5.35 ±5.3 E-16	1.28 ±0.2 E-14			
3rd Qtr			< 4.37 E-17	< 3.40 E-16	< 4.23 E-16
OCT	7.84 ±6.7 E-16	2.40 ±0.3 E-14			
NOV	< 6.88 E-16	1.97 ±0.3 E-14			
DEC	1.02 ±0.8 E-15	2.34 ±0.3 E-14			
4th Qtr			< 4.25 E-17	< 3.50 E-16	< 4.20 E-16

Table C - 2. 14

1989 Radioactivity Concentrations in Airborne Particulate at Route 240 Air Sampler (AFRT240) (μCi/mL)

Month	Alpha	Beta	Strontium-90	Cesium-137
JAN	1.18 ±0.9 E-15	3.23 ±0.4 E-14		
FEB	1.45 ±0.9 E-15	2.73 ±0.4 E-14		
MAR	8.47 ±7.6 E-16	2.08 ±0.3 E-14		
1st Qtr			<7.69 E-17	<8.77 E-16
APR	1.25 ±0.9 E-15	1.89 ±0.3 E-14		
MAY	<6.78 E-16	1.36 ±0.3 E-14		
JUN	7.97 ±7.6 E-16	1.90 ±0.4 E-14		
2nd Qtr			<1.74 E-16	<5.08 E-16
JUL	1.26 ±1.0 E−15	1.88 ±0.4 E-14		
AUG	1.42 ±1.0 E-15	2.11 ±0.4 E-14		
SEP	<8.06 E-16	1.63 ±0.3 E-14		
3rd Qtr			<4.88 E-17	<6.78 E-16
OCT	1.29 ±0.9 E-15	2.70 ±0.4 E-14		
NOV	8.56 ±7.8 E-16	1.87 ±0.3 E-14		
DEC	9.55 ±8.0 E-16	2.36 ±0.4 E-14		
4th Qtr			5.09 ±2.5 E-17	<5.05 E-16

Table C - 2. 15

1989 Radioactivity Concentrations in Airborne Particulate at Springville Air Sampler (AFSPRVL) (μCi/mL)

Month	Alpha	Beta	Strontium-90	Cesium-137
JAN	<8.1 E-16	3.52 ±0.5 E-14		
FEB	1.74 ±1.1 E-15	3.28 ±0.5 E-14		
MAR	<1.0 E-15	2.90 ±0.5 E-14		
1st Qtr			<5.24 E-17	<9.61 E-16
APR	1.36 ±1.1 E-15	2.63 ±0.4 E-14		
MAY	<1.3 E-15	2.80 ±0.5 E-14		
JUN	<1.2 E-15	3.20 ±0.6 E-14		
2nd Qtr			<4.04 E-16	<4.49 E-16
JUL	1.64 ±1.2 E-15	2.37 ±0.4 E-14		
AUG	2.05 ±1.3 E-15	2.59 ±0.4 E-14		
SEP	1.75 ±1.5 E-15	3.40 ±0.6 E-14		
3rd Qtr			<6.32 E-17	<7.61 E-16
OCT	2.53 ±2.1 E-15	4.42 ±0.5 E-14		
NOV	3.12 ±3.1 E-15	8.23 ±1.4 E-14		
DEC	2.21 ±1.6 E-15	4.85 ±0.7 E-14		
4th Qtr			<9.01 E-17	<1.17 E-15

Table C - 2. 16

1989 Radioactivity Concentrations in Airborne Particulates at Thomas Corners Air Sampler (AFTCORD) (μCi/mL)

Month	Alpha	Beta	Strontium-90	Cesium-137
JAN	1.47 ± 0.8 E-15	2.38 ±0.3 E-14		
FEB	9.32 ±6.5 E-16	2.34 ±0.3 E-14		
MAR	1.20 ±0.8 E-15	2.06 ±0.3 E-14		
1st Qtr			<5.37 E-17	<6.69 E-16
APR	4.12 ±0.8 E-15	1.84 ±0.3 E-14		
MAY	<5.6 E-16	1.44 ±0.3 E-14		
JUN	9.70 ±7.3 E-16	1.53 ±0.3 E-14		
2nd Qtr			<1.34 E-16	<6.15 E-16
JUL	9.80 ±8.0 E-16	1.54 ±0.3 E-14		
AUG	1.30±0.8 E-15	1.94 ±0.3 E-14		
SEP	7.71 ±7.0 E-16	1.57 ±0.3 E-14		
3rd Qtr			7.65 ± 2.3 E-17	<3.86 E-16
OCT	7.39 ±6.5 E-16	2.23 ±0.3 E-14		
NOV	<6.0 E-16	1.67 ±0.3 E-14		
DEC	1.03 ±0.7 E-15	2.21 ±0.3 E-14		
4th Qtr			4.70 ± 2.0 E-17	<4.25 E-16

Table C - 2.17

1989 Radioactivity Concentrations in Airborne Particulates at West Valley Air Sampler (AFWEVAL)(μCi/mL)

Month	Alpha	Beta	Strontium-90	Cesium-137
JAN	1.33 ±0.8 E-15	2.88 ±0.4 E-14		
FEB	1.17 ±0.8 E-15	2.67 ±0.3 E-14		
MAR	1.13 ±0.8 E-15	2.14 ±0.3 E-14		
1st Qtr			<4.09 E-17	<8.48 E-16
APR	8.50 ±6.8 E-16	1.96 ±0.3 E-14		
MAY	<5.5 E-16	1.50 ±0.3 E-14		
JUN	7.61 ±6.1 E-16	1.60 ±0.3 E-14		
2nd Qtr			<1.14 E-16	<4.20 E-16
JUL	1.54 ±0.9 E-15	1.70 ±0.3 E-14		
AUG	9.47 ±7.0 E-16	1.77 ± 0.3 E-14		
SEP	6.95 ±6.5 E-16	1.52 ±0.3 E-14		
3rd Qtr			4.83 ± 2.4 E-17	<4.38 E-16
OCT	1.87 ±1.3 E-15	3.48 ±0.5 E-14		
NOV	1.02 ±1.0 E-15	2.51 ±0.4 E-14		
DEC	1.91 ±1.3 E-15	3.83 ±0.5 E-14		
4th Qtr			1.03 ± 0.3 E-16	<5.75 E-16

Table C - 2.18

1989 Radioactivity Concentrations in Airborne Particulate at Great Valley Air Sampler (AFGRVAL) (μCi/mL)

Month	Alpha	Beta	Strontium-90	Iodine-129	Cesium-137
JAN	9.34 ±7.5 E-16	3.01 ±0.4 E-14			
FEB	1.10 ±0.8 E-15	2.63 ±0.4 E-14			
MAR	1.11 ±0.8 E-15	1.94 ±0.3 E-14			
1st Qtr			<3.90 E-17	<3.89 E-16	<7.74 E-16
APR	1.40 ±0.9 E-15	1.67 ±0.3 E-14			
MAY	5.84 ±4.9 E-16	1.27 ±0.2 E-14			
JUN	1.19 ±0.8 E-15	1.80 ±0.3 E-14			
2nd Qtr			<1.68 E-16	<3.30 E-16	<5.98 E-16
JUL	1.39 ±0.9 E-15	1.79 ±0.3 E-14			
AUG	9.67 ±6.9 E-16	1.97 ±0.3 E-14			
SEP	<5.60E-16	1.66±0.3 E-14			
3rd Qtr			9.23 ± 2.5 E-17	<3.55 E-16	<4.19 E-16
OCT	1.11 ±0.9 E-15	2.49 ±0.4 E-14			
NOV	<6.50 E-16	1.83 ±0.3 E-14			
DEC	1.50 ±0.9 E-15	2.46 ±0.3 E-14			
4th Qtr			5.89 ± 2.1 E-17	<3.66 E-16	<4.85 E-16

Table C - 2.19

1989 Radioactivity Concentrations in Airborne Particulate at Dunkirk Air Sampler (AFDNKRK) (μCi/mL)

Month	Alpha	Beta	Strontium-90	Cesium - 137
JAN	1.33 ±1.0 E-15	3.36 ±0.4 E-14		
FEB	1.70 ±1.3 E-15	3.46 ±0.5 E-14		
MAR	9.33 ±8.7 E-16	2.07 ±0.3 E-14		
1st Qtr			<5.66 E-17	<1.02 E-15
APR	<6.1 E-16	1.81 ±0.9 E-14		
MAY	<6.7 E-16	1.54 ±0.3 E-14		
JUN	7.87 ±7.8 E-16	2.43 ±0.4 E-14		
2nd Qtr			<1.37 E-16	<8.02 E-16
JUL	1.58 ±1.0 E-15	2.10 ±0.4 E-14		
AUG	1.43 ±0.9 E-15	2.25 ±0.4 E-14		
SEP	<7.1 E-16	1.91 ±0.3 E-14		
3rd Qtr			7.50 ± 2.6 E-17	<5.27 E-16
OCT	1.29 ±0.9 E-15	2.60 ±0.4 E-14		
NOV	9.49 ±7.3 E-16	2.01 ±0.3 E-14		
DEC	1.23 ±0.9 E-15	2.47 ±0.4 E-14		
4th Qtr			4.92 ± 2.3 E-17	<5.23 E-16

Table C - 2. 20

1989 Radioactivity Concentrations in Airborne Particulates at Dutch Hill Air Sampler (AFBOEHN) (μCi/mL)

Month	Alpha	Beta	Strontium-90	Cesium-137
JAN	9.69 ±7.4 E-16	2.62 ±0.3 E-14		
FEB	1.55 ±0.9 E-15	2.48 ±0.3 E-14		
MAR	6.85 ±6.6 E-16	1.98 ±0.3 E-14		
1st Qtr			<4.10 E-17	5.56 ± 4.4 E-16
APR	1.18 ±0.8 E-15	1.93 ±0.3 E-14		
MAY	7.62 ±6.7 E-16	1.43 ±0.3 E-14		
JUN	7.02 ±6.4 E-16	1.54 ±0.3 E-14		
2nd Qtr			<1.22 E-16	<5.95 E-16
JUL	9.73 ±8.0 E-16	1.71 ±0.3 E-14		
AUG	1.34 ±0.9 E-15	1.69 ± 0.3 E-14		
SEP	7.59 ±7.3 E-16	1.49 ± 0.3 E-14		
3rd Qtr			<3.84 E-17	<4.52 E-16
OCT	1.02 ±0.8 E−15	2.33 ±0.3 E-14		
NOV	<1.11E-15	1.46 ±0.4 E-14		
DEC	1.37 ±1.0 E-15	2.04 ±0.3 E-14		
4th Qtr			<4.54 E-17	<5.53 E-16

Table C - 2. 21

Radioactivity in Fallout during 1989 (nCi/m^2/mo)

Dutch Hill (AFDHFOP)

MONTH	Gross Alpha	Gross Beta	H-3 (μCi/mL)
JANUARY	5.4 E-03	1.1 E-01	< 1.0 E-07
FEBRUARY	2.8 E-02	1.8 E-01	< 1.2 E-07
MARCH	5.0 E-02	3.0 E-01	< 1.0 E-07
APRIL	4.4 E-02	2.8 E-01	< 1.0 E-07
MAY	3.8 E-02	3.4 E-01	< 1.0 E-07
JUNE	4.6 E-02	3.4 E-01	< 1.0 E-07
JULY	5.3 E-02	2.9 E-01	< 1.0 E-07
AUGUST	1.2 E-02	1.9 E-01	< 1.0 E-07
SEPTEMBER	2.2 E-02	2.0 E-01	< 1.0 E-07
OCTOBER	1.1 E-02	1.6 E-01	2.70 ± 1.1 E−07
NOVEMBER	4.8 E-02	3.5 E-01	< 1.0 E-07
DECEMBER	1.0 E-02	1.2 E-01	< 1.0 E-07

Fox Valley Road (AFFXFOP)

MONTH	Gross Alpha	Gross Beta	H-3 (μCi/mL)
JANUARY	2.1 E-02	2.6 E-01	< 1.0 E-07
FEBRUARY	3.7 E-02	2.7 E-01	< 1.0 E-07
MARCH	9.6 E-02	4.8 E-01	< 1.0 E-07
APRIL	8.3 E-02	3.2 E-01	< 1.2 E-07
MAY	6.4 E-02	4.3 E-01	< 1.0 E-07
JUNE	6.2 E-02	3.6 E-01	< 1.0 E-07
JULY	2.8 E-02	1.7 E-01	< 1.0 E-07
AUGUST	1.6 E-02	1.4 E-01	< 1.0 E-07
SEPTEMBER	1.2 E-02	3.7 E-01	< 1.0 E-07
OCTOBER	1.1 E-02	3.5 E-01	< 1.0 E-07
NOVEMBER	7.5 E-02	4.9 E-01	< 1.0 E-07
DECEMBER	3.2 E-02	2.4 E-01	2.16 ±1.2 E−07

Route 240 (AF24FOP)

MONTH	Gross Alpha	Gross Beta	H-3 (μCi/mL)
JANUARY	3.0 E-02	1.9 E-01	< 1.0 E-07
FEBRUARY	4.1 E-02	1.9 E-01	< 1.0 E-07
MARCH	5.9 E-02	3.8 E-01	< 1.0 E-07
APRIL	4.0 E-02	2.9 E-01	2.21 ±1.2 E-07
MAY	3.4 E-02	3.7 E-01	< 1.0 E-07
JUNE	4.1 E-02	5.7 E-01	< 1.0 E-07
JULY	1.9 E-02	2.6 E-01	SAMPLE DRY
AUGUST	2.6 E-02	3.0 E-01	< 1.0 E-07
SEPTEMBER	2.4 E-02	2.8 E-01	< 1.0 E-07
OCTOBER	2.5 E-02	4.9 E-01	< 1.0 E-07
NOVEMBER	4.4 E-02	4.0 E-01	< 1.0 E-07
DECEMBER	1.7 E-02	2.1 E-01	1.56 ±1.2 E−07

Thomas Corners Road (AFTCFOP)

MONTH	Gross Alpha	Gross Beta	H-3 (μCi/mL)
JANUARY	4.2 E-02	2.8 E-01	< 1.0 E-07
FEBRUARY	3.0 E-02	1.9 E-01	< 1.0 E-07
MARCH	4.5 E-02	4.0 E-01	< 1.0 E-07
APRIL	7.2 E-02	3.4 E-01	< 1.0 E-07
MAY	6.3 E-02	4.1 E-01	< 1.0 E-07
JUNE	7.9 E-02	3.6 E-01	< 1.0 E-07
JULY	1.8 E-02	1.8 E-01	SAMPLE DRY
AUGUST	3.1 E-02	2.2 E-01	< 1.0 E-07
SEPTEMBER	2.6 E-02	2.1 E-01	< 1.0 E-07
OCTOBER	2.6 E-02	2.6 E-01	< 1.0 E-07
NOVEMBER	1.1 E-01	6.3 E-01	< 1.0 E-07
DECEMBER	3.3 E-02	2.2 E-01	1.32 ±1.2 E-07

Note: Gross alpha uncertainty is ± 60%; gross beta uncertainty is ± 10%

Table C - 2. 22

pH of Precipitation Collected in Fallout Pots in 1989

	Dutch Hill *	Fox Valley Road*	Route 240*	Thomas Corners Road*
JANUARY	3.71	4.44	3.74	4.07
FEBRUARY	4.14	5.36	4.10	4.42
MARCH	4.18	6.00	4.23	6.09
APRIL	4.17	5.84	4.53	6.03
MAY	4.06	4.11	3.90	4.21
JUNE	3.94	3.94	4.98	3.81
JULY	6.29	3.53	DRY	DRY
AUGUST	4.24	3.53	5.75	3.75
SEPTEMBER	4.65	4.81	4.06	4.10
OCTOBER	6.15	5.62	7.03	4.11
NOVEMBER	4.08	4.49	3.95	4.14
DECEMBER	4.29	4.22	4.17	4.15

* LOCATION CODE

Dutch Hill - AFDHFOP

Fox Valley Road - AFFXFOP

Route 240 - AF24FOP

Thomas Corners Road - AFTCFOP

Table C - 2. 22

pH of Precipitation Collected in Fallout Pots in 1989

	Dutch Hill *	Fox Valley Road*	Route 240*	Thomas Corners Road*
JANUARY	3.71	4.44	3.74	4.07
FEBRUARY	4.14	5.36	4.10	4.42
MARCH	4.18	6.00	4.23	6.09
APRIL	4.17	5.84	4.53	6.03
MAY	4.06	4.11	3.90	4.21
JUNE	3.94	3.94	4.98	3.81
JULY	6.29	3.53	DRY	DRY
AUGUST	4.24	3.53	5.75	3.75
SEPTEMBER	4.65	4.81	4.06	4.10
OCTOBER	6.15	5.62	7.03	4.11
NOVEMBER	4.08	4.49	3.95	4.14
DECEMBER	4.29	4.22	4.17	4.15

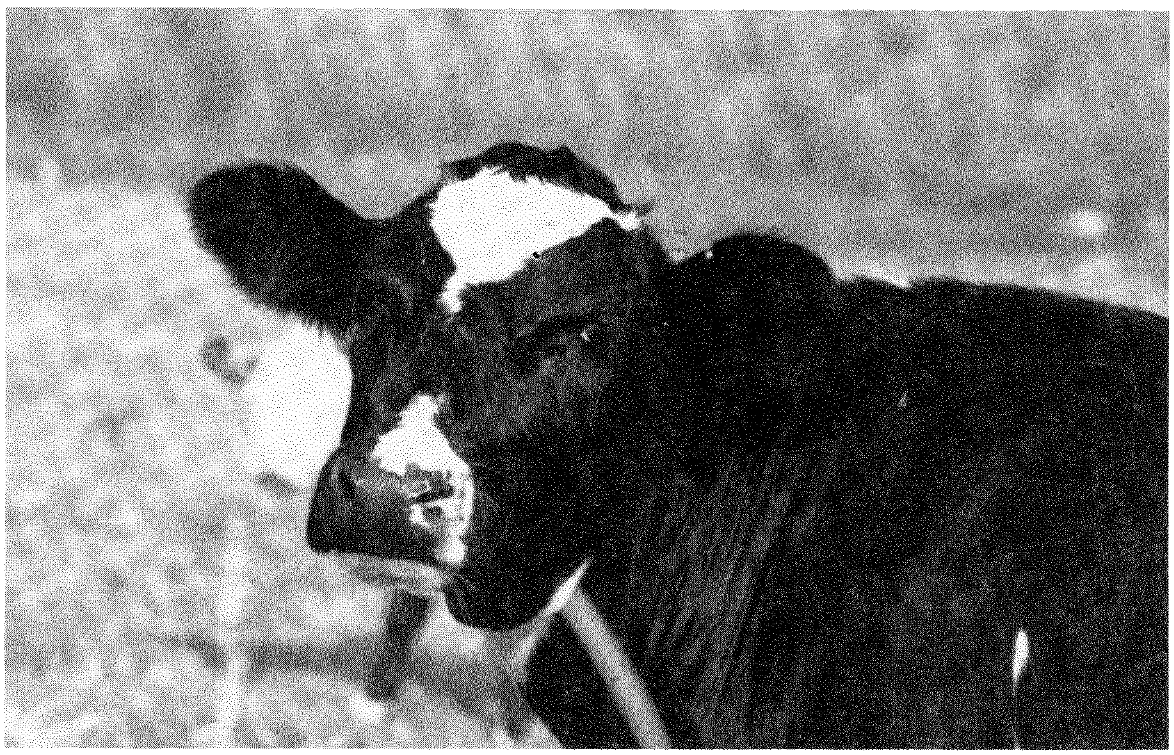
*** LOCATION CODE**

Dutch Hill - AFDHFOP

Fox Valley Road - AFFXFOP

Route 240 - AF24FOP

Thomas Corners Road - AFTCFOP



WHAT SORT OF SAMPLE DO YOU WANT?

APPENDIX C - 3

SUMMARY OF BIOLOGICAL SAMPLE DATA

Table C - 3. 1

Radioactivity Concentrations in Milk (μCi/mL) - 1989

Location	H-3	Sr-90	I-129	Cs-134	Cs-137
NNW Farm (BFMREED) 1st Qtr 1989	<2.01 E-07	<2.00 E-09	<7.96 E-10	<6.09 E-09	<8.10 E-09
WNW Farm (BFMCOBO) 1st Qtr 1989	<2.01 E-07	<2.00 E-09	<7.96 E-10	<5.56 E-09	<5.25 E-09
Control (BFMCTLS) 1st Qtr 1989	<2.01 E-07	<2.00 E-09	<7.96 E-10	<6.43 E-09	<9.62 E-09
Control (BFMCTLN) 1st Qtr 1989	<2.01 E-07	<2.00 E-09	<7.96 E-10	<7.44 E-09	<9.92 E-09
NNW Farm (BFMREED) 2nd Qtr 1989	<2.0 E-07	<2.0 E-09	<8.0 E-10	<2.85 E-09	<3.15 E-09
WNW Farm (BFMCOBO) 2nd Qtr 1989	<2.0 E-07	<2.0 E-09	<8.0 E-10	<3.10 E-09	<4.06 E-09
Control (BFMCTLS) 2nd Qtr 1989	<2.0 E-07	<2.0 E-09	<8.0 E-10	<2.56 E-09	<2.65 E-09
Control (BFMCTLN) 2nd Qtr 1989	<2.0 E-07	4.14 ± 0.47 E-09	<8.0 E-10	<2.98 E-09	<4.13E-09
NNW Farm (BFMREED) 3rd Qtr 1989	<1.27 E-07	1.13 ± 0.34 E-09	<8.0 E-10	<2.52E-09	<2.79E-09
WNW Farm (BFMCOBO) 3rd Qtr 1989	2.81 ± 1.37 E-07	3.40 ±0.41 E-09	<8.0 E-10	<4.75E-09	<6.40E-09
Control (BFMCTLS) 3rd Qtr 1989	2.35±1.34E-07	1.94±0.33E-09	8.32±4.06E-10	<5.65E-09	<6.72E-09
Control (BFMCTLN) 3rd Qtr 1989	2.34±0.33E-06	2.56±0.34E-09	<8.0E-10	<5.40E-09	<5.80E-09
NNW Farm (BFMREED) 4th Qtr 1989	<2.2 E-07	2.72 ± 0.36 E-09	<8.06 E-10	<8.51 E-09	<9.17 E-09
WNW Farm (BFMCOBO) 4th Qtr 1989	<2.2 E-07	4.57 ± 0.53 E-09	<8.06 E-10	<6.86 E-09	<9.07 E-09
Control (BFMCTLS) 4th Qtr 1989	<2.2 E-07	2.15 ± 0.29 E-09	<8.06 E-10	<9.30 E-09	<1.04 E-08
Control (BFMCTLN) 4th Qtr 1989	<2.2 E-07	3.01 ± 0.37 E−09	<8.06 E-10	<9.09 E-09	<1.10 E-08
SE Farm (BFMWIDR) September 1989	5.18 ±1.51 E-07	3.89±0.58 E-09	<8.0 E-10	<5.36E-09	<6.51E-09
SSW Farm (BFMHAUR) September 1989	9.94 ±1.85 E-07	4.75 ± 0.55 E-09	<8.0 E-10	<5.36E-09	<5.09E-09

Table C - 3. 2

Radioactivity Concentrations in Meat (μCi/g Dry) – 1989

Location	% Moisture	Sr-90	Cs-134	Cs-137	K-40
Deer Flesh - Near Site (BFDNEAR #1) 12/89	74.5	9.66 ± 1.80 E–09	not reported	<8 E-08	3.41 ± 0.56 E-07
Deer Flesh - Near Site (BFDNEAR #2) 12/89	42.5	2.89 ± 1.30 E–09	not reported	<8 E-08	9.38 ± 1.27 E-06
Deer Flesh - Near Site (BFDNEAR #3) 12/89	73.8	<1.80 E-09	not reported	<8 E-08	5.05 ± 0.83 E–06
Deer Flesh - Background (BFDCTRL #1) 11/89	69.6	6.12 ± 1.34 E–09	not reported	<8 E-08	3.38 ± 0.56 E-06
Deer Flesh - Background (BFDCTRL #2) 12/89	68.0	4.62 ± 1.56 E –09	not reported	<8E-08	5.66 ± 0.78 E-06
Deer Flesh - Background (BFDCTRL #3) 12/89	73.6	7.04 ± 2.15 E–09	<1.52 E-08	5.84 ± 1.96 E-08	1.03 ± 0.16 E-05
Beef Flesh - Background (BFBCTRL) 7/89	77.3	5.20 ± 1.48 E–09	<6.15 E-09	<8.07 E-09	1.14 ± 0.12 E-05
Beef Flesh - Near Site (BFBNEAR) 7/89	74.8	8.21 ± 1.83 E–09	<5.13 E-09	<6.47 E-09	5.20 ± 0.56 E-06
Beef Flesh - Background (BFBCTRL) 11/89	74.0	3.08 ± 1.39 E–09	not reported	1.54 ± 0.35 E-07	7.35 ± 1.04 E-06
Beef Flesh - Near Site (BFBNEAR) 12/89	75.9	1.20 ± 0.22 E–08	<3 E-08	<3 E-08	1.37 ± 0.15 E-05

Table C - 3. 3

Radioactivity Concentrations in Food Crops (μCi/g Dry) - 1989

Location	% Moisture	H-3 (μCi/ml)	Sr-90	K-40	Co-60	Cs-137
Beans - Near-site (BFVNEAR)	95	1.18 ± 0.93 E–05	1.68 ± 0.23 E-07	3.85 ±0.66 E-05	<2.87 E-07	<1.92 E-07
Beans-Background (BFVCTRL)	95	1.97 ± 1.01 E–05	2.93 ± 0.28 E-07	3.51 ±0.70 E-05	<4.13 E-07	<2.89 E-07
Tomatoes - Near-site (BFVNEAR)	97	<1.25 E-05	5.10 ± 1.38 E–08	5.40 ± 0.84 E-05	<3.97E-07	<2.64 E-07
Tomatoes-Background (BFVCTRL)	97	<1.27 E-05	4.73 ± 1.46 E–08	6.21 ± 1.10 E-05	<4.38E-07	<2.03 E-07
Corn - Near-site (BFVNEAR)	76	<2.45 E-06	2.80 ± 1.66 E–09	4.77 ± 1.90 E-06	<2.69E-07	<1.53 E-07
Corn-Background (BFVCTRL)	93	<1.02 E-05	9.30 ± 8.34 E–09	5.53 ± 1.40 E-05	<1.06E-06	<5.22 E-07
Hay-Near-site (BFHNEAR)	N/A	N/A	4.08±0.87E-08	2.96±0.54E-05	<3.24E-07	<1.78E-07
Hay-Background (BFHCTLS)	N/A	N/A	2.76±0.44E-08	1.20±0.26E-05	<2.18E-07	<1.47E-07

Table C - 3. 4

Radioactivity Concentrations in Fish from Cattaraugus Creek (μCi/g -Dry) - 1989

Cattaraugus Creek (BFFCATC) above Springville Dam 2nd Quarter (Flesh)

	Sr-90	Cs-134	Cs-137
Median	6.35 E-08	< 1.72 E-07	< 2.00 E-07
Geometric Deviation (Avg)	2.74	1.40	1.38
Maximum	2.04 E-07	< 2.7 E-07	< 3.0 E-07
Minimum	2.05 E-08	< 1.1 E-07	< 1.3 E-07
Moisture (Average %)	79.1		

Cattaraugus Creek (BFFCATC) 3rd Quarter (Flesh)

	Sr-90	Cs-134	Cs-137
Median	< 2.90 E-08	< 5.00 E-07	< 5.20 E-07
Geometric Deviation (Avg)	1.59	1.75	1.67
Maximum	4.32 E-08	< 7.9 E-07	< 7.9 E-07
Minimum	< 1.3 E-08	< 2.4 E-07	< 2.5 E-07
Moisture (Average %)	80.0		

Cattaraugus Creek (BFFCTRL) Background 2nd Quarter(Flesh)

	Sr-90	Cs-134	Cs-137
Median	2.05 E-08	< 1.34 E-07	< 1.45 E-07
Geometric Deviation (Avg)	2.02	1.78	1.68
Maximum	5.75 E-07	< 2.0 E-07	3.79 E-07
Minimum	< 1.3 E-08	< 4.7 E-08	< 9.4 E-08
Moisture (Average %)	76.9		

Cattaraugus Creek (BFFCTRL) Background 3rd Quarter(Flesh)

	Sr-90	Cs-134	Cs-137
Median	< 1.90 E-08	< 3.10 E-07	< 3.25 E-07
Geometric Deviation (Avg)	1.77	1.68	1.60
Maximum	< 3.3 E-08	< 4.6 E-07	< 5.6 E-07
Minimum	< 7.6 E-09	< 1.4 E-07	< 1.7 E-07
Moisture (Average %)	79.7		

Cattaraugus Creek (BFFCATD) Below Springville Dam 2nd Quarter (Flesh)

	Sr-90	Cs-134	Cs-137
Median	5.20 E-08	< 1.01 E-07	< 1.26 E-07
Geometric Deviation (Avg)	4.32	1.84	1.80
Maximum	3.35 E-07	< 2.2 E-07	3.33 E-07
Minimum	< 9.7 E-09	< 5.0 E-08	< 6.1 E-08
Moisture (Average %)	79.1		

Cattaraugus Creek (BFFCATD) 3rd Quarter (Flesh)

	Sr-90	Cs-134	Cs-137
Median	< 2.75 E-08	< 3.00 E-07	< 3.25 E-07
Geometric Deviation (Avg)	6.08	2.88	2.58
Maximum	1.88 E-07	< 8.2 E-07	< 9.2 E-07
Minimum	< 2.0 E-09	< 7.2 E-08	< 1.1 E-07
Moisture (Average %)	81.8		

CHANGING A PERIMETER TLD

APPENDIX C - 4

SUMMARY OF DIRECT RADIATION MONITORING DATA

Table C - 4. 1

Summary of Quarterly Averages of TLD Measurements for 1989 *(in roentgen ± 3 St. Dev./quarter)*

Location	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Location Average
1	.018 ± .002	.020 ± .002	.022 ± .006	.020 ± .003	.020 ± .003
2	.018 ± .004	.019 ± .002	.021 ± .004	.018 ± .004	.019 ± .004
3	.016 ± .002	.017 ± .004	.021 ± .003	.018 ± .005	.018 ± .004
4	.018 ± .002	.017 ± .004	.021 ± .004	.018 ± .004	.019 ± .003
5	.018 ± .003	.019 ± .002	.023 ± .002	.020 ± .008	.020 ± .004
6	.017 ± .004	.030 ± .019	.020 ± .001	.019 ± .005	.021 ± .007
7	.017 ± .003	.017 ± .004	.021 ± .003	.017 ± .004	.018 ± .003
8	.017 ± .003	.017 ± .002	.022 ± .004	.018 ± .009	.019 ± .005
9	.017 ± .003	.017 ± .005	.021 ± .003	.018 ± .004	.018 ± .004
10	.018 ± .004	.017 ± .003	.025 ± .015	.019 ± .008	.020 ± .008
11	.020 ± .002	.020 ± .006	.024 ± .004	.021 ± .005	.021 ± .004
12	.017 ± .002	.016 ± .003	.024 ± .004	.017 ± .004	.019 ± .003
13	.019 ± .003	.019 ± .004	.026 ± .006	.020 ± .004	.021 ± .004
14	.019 ± .002	.018 ± .005	.024 ± .004	.019 ± .005	.020 ± .004
15	.018 ± .004	***	.022 ± .002	.019 ± .004	.020 ± .003
16	.018 ± .004	.018 ± .003	.024 ± .004	.019 ± .005	.020 ± .004
17	.020 ± .002	.018 ± .009	.023 ± .002	.021 ± .006	.021 ± .005
18**	.026 ± .004	.026 ± .003	.037 ± .005	.034 ± .011	.031 ± .005
19**	.021 ± .004	.020 ± .005	.027 ± .004	.022 ± .009	.023 ± .006
20	.017 ± .004	.017 ± .004	.024 ± .003	.019 ± .005	.019 ± .004
21	.018 ± .004	.018 ± .004	.023 ± .003	.018 ± .006	.019 ± .004
22	.018 ± .004	.017 ± .003	.023 ± .006	.017 ± .007	.019 ± .005
23	.015 ± .002	.016 ± .004	.023 ± .003	.016 ± .004	.017 ± .003
24**	1.446 ± .325	1.353 ± .393	1.484 ± .300	1.449 ± .226	1.433 ± .311
25	.032 ± .002	.032 ± .007	.040 ± .007	.032 ± .007	.034 ± .006
26	.030 ± .007	.029 ± .003	.039 ± .004	.029 ± .011	.032 ± .006
27	.021 ± .002	.020 ± .005	.028 ± .004	.018 ± .006	.022 ± .004
28	.019 ± .002	.020 ± .005	.027 ± .004	.020 ± .006	.021 ± .004
29	.022 ± .004	.024 ± .005	.033 ± .008	.024 ± .005	.026 ± .005
30	.029 ± .005	.029 ± .010	.038 ± .006	.031 ± .003	.032 ± .006
31	.019 ± .003	.018 ± .004	.024 ± .002	.019 ± .007	.020 ± .004
32	.020 ± .005	.020 ± .003	.031 ± .007	.025 ± .004	.024 ± .005
33	.021 ± .003	.021 ± .005	.030 ± .005	.026 ± .010	.024 ± .006
34	.026 ± .004	.029 ± .005	.049 ± .010	.041 ± .005	.036 ± .006
35	.027 ± .004	.029 ± .008	.046 ± .007	.046 ± .012	.037 ± .008
36	.034 ± .006	.037 ± .008	.056 ± .006	.055 ± .009	.045 ± .007
37	.017 ± .003	.015 ± .002	.023 ± .010	.017 ± .004	.018 ± .005
38**	.042 ± .007	.042 ± .011	.051 ± .011	.043 ± .007	.045 ± .009
39**	.085 ± .012	.085 ± .009	.099 ± .015	.090 ± .008	.090 ± .011
40**	.200 ± .031	.183 ± .046	.203 ± .038	.211 ± .032	.199 ± .037
41			.020 ± .003	.016 ± .004	.018 ± .010
Quarterly Average**	.020 ± .003	.021 ± .005	.027 ± .005	.022 ± .006	.023 ± .005

* Locations are shown in Figures A-7, A-8, and A-9. TLD 41 put in place third quarter.

** TLDs 18, 19, 24, 38, 39, and 40 are not included in the quarterly average. *** TLD package missing

Figure C-4. 1

Average Quarterly Gamma Exposure Rates (μR/hr) around the West Valley Demonstration Project — 1989

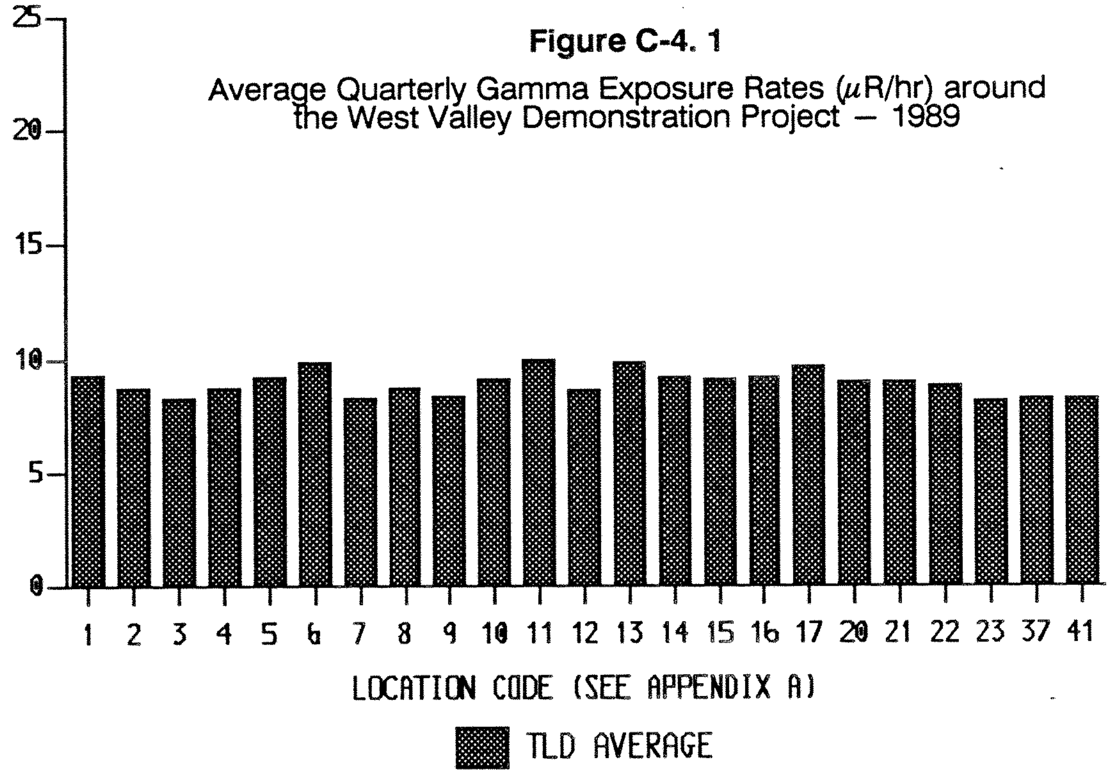
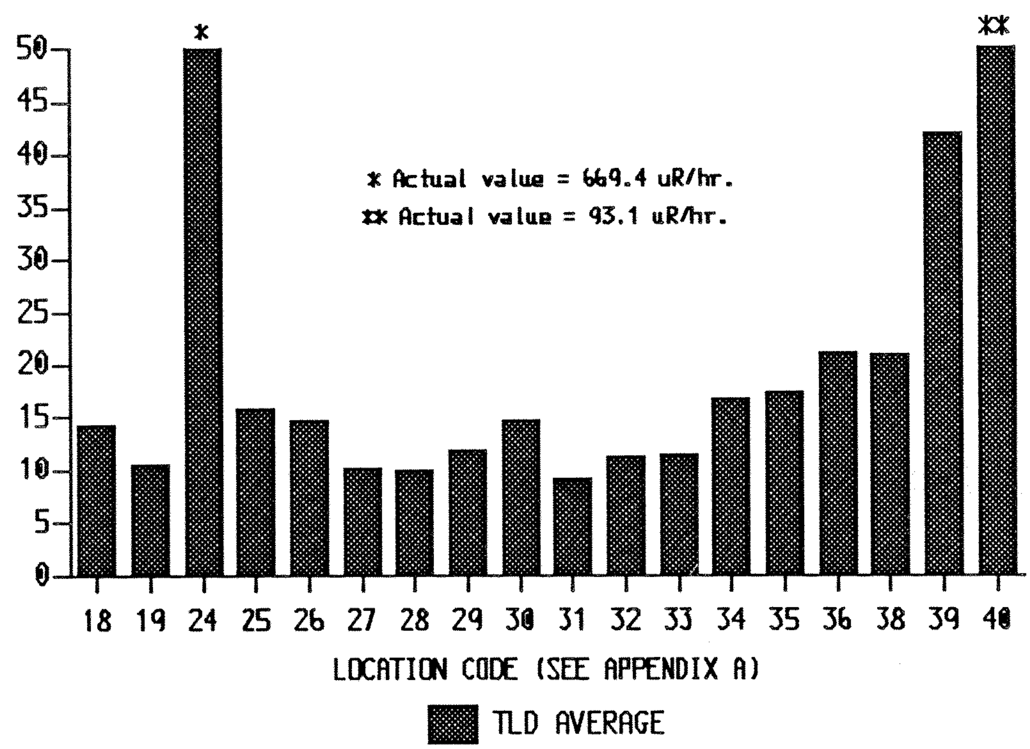


Figure C- 4. 2

Average Quarterly Gamma Exposure Rates On-Site — 1989

μR/hr



SURFACE WATER SAMPLING

APPENDIX C -5

SUMMARY OF NONRADIOLOGICAL MONITORING DATA

Table C - 5. 1

West Valley Demonstration Project Environmental Permits Calendar Year 1989

Permit #	Issued by	Expiration	Type of Permit
042200–0114–00002 WC	NYSDEC	6/94	Certificate to Operate Air Contamination Source: boiler
042200–0114–00003 WC	NYSDEC	6/94	Certificate to Operate Air Contamination Source: boiler
042200–0114–00004 WR	NYSDEC	6/94	Certificate to Operate Air Contamination Source: incinerator**
042200–0114–0010 WI	NYSDEC	6/94	Certificate to Operate Air Contamination Source: Low-level Waste Treatment Facility Nitric Acid Storage Tank
042200–0114–014D1 WI	NYSDEC	6/94	Certificate to Operate Air Contamination Source: Nitric Acid Bulk Storage Tank
042200–0114–CSS01	NYSDEC	6/94	Certificate to Operate Cement Storage Silo Ventilation System
042200–0114–015F–1	NYSDEC	6/86*	Permit to Construct Vitrification Off-Gas System
042200–0114–CTS01	NYSDEC	3/90	Permit to Construct CTS Cold Chemical Makeup System
042200–0114–CTS02	NYSDEC	3/90	Permit to Construct CTS Cold Chemical Makeup System
042200–0114–CTS03	NYSDEC	3/90	Permit to Construct CTS Cold Chemical Makeup System
NY–0000973	NYSDEC	9/90	State Pollutant Discharge Elimination System (SPDES permit)
WVDP–187–01	EPA		Certificate to Operate Radioactive Air Source: Building 01–14 Ventilation System***
WVDP–287–01	EPA		Certificate to Operate Radioactive Air Source: Contact Size Reduction & Decontamination Facility***
WVDP–387–01	EPA		Certificate to Operate Radioactive Air Source: Supernatant Treatment Ventilation System***

West Valley Demonstration Project Environmental Permits Calendar Year 1989

Permit #	Issued by	Expiration	Type of Permit
WVDP–487–01	EPA		Certificate to Operate Radioactive Air Source: Low-level Waste Supercompactor Ventilation system***
WVDP–587–01	EPA		Certificate to Operate Radioactive Air Source: Outdoor Ventilation System
WVDP–687–01	EPA		Certificate to Operate Radioactive Air Source: Liquid Waste Treatment System (modification of Process BuildingVentilation System)***
WVDP–687–01	EPA		Permit to construct or modify sources of atmospheric emissions of radionuclides : Analytical Chemistry Laboratories (modification of Process Building Ventilation System***

* Permit to construct was extended annually with submittal of semiannual report. Permit was discontinued in November 1989 when the testing phase was completed.

** Nonradioactive waste currently is removed to a commercial landfill and not incinerated.

*** National Emission Standard of Hazardous Air Pollutants (NESHAP) temporary permits are valid until the final permits are issued.

Table C - 5. 2

West Valley Demonstration Project State Pollutant Discharge Elimination System (SPDES) Sampling Program
Effective September 1, 1985

OUTFALL	Parameter	Limit	Sample Frequency
001 (PROCESS AND STORM WASTE WATER)	Flow	Monitor	2 per discharge
	Aluminum, total	14.0 mg/L	2 per discharge
	Ammonia (NH3)	*	2 per discharge
	Arsenic, dissolved	0.15 mg/L	2 per discharge
	BOD-5	**	2 per discharge
	Iron, total	**	2 per discharge
	Zinc, total recoverable	0.48 mg/L	2 per discharge
	Solids, suspended	45.0 mg/L	2 per discharge
	Cyanide, amenable to chlor/	0.022 mg/L	2 per discharge
	Solids, settleable	0.30ml/L	2 per discharge
	pH (range)	6.0 - 9.0	2 per discharge
	Oil & grease	15.0 mg/L	2 per discharge
	Sulfate	Monitor	2 per discharge
	Nitrate	Monitor	2 per discharge
	Chromium (hexavalent), total rec	0.016 mg/L	2 per discharge
	Cadmium, total recoverable	0.007 mg/L	2 per discharge
	Copper, total recoverable	0.03 mg/L	2 per discharge
	Lead, total recoverable	0.15 mg/L	2 per discharge
	Chromium, total	0.050 mg/L	annual
	Nickel, total	0.080 mg/L	annual
	Selenium, total	0.040 mg/L	annual
	Barium	0.5 mg/L	annual
	Antimony	1.0 mg/L	annual
	Chloroform	0.3 mg/L	annual
007 (SANITARY AND UTILITY WASTE WATER)	Flow	Monitor	3 per month
	Ammonia (NH3)	*	3 per month
	BOD-5	**	3 per month
	Iron, total	**	3 per month
	Suspended solids	45.0 mg/L	2 per month
	Settleable solids	0.3 ml/L	weekly
	pH (range)	6.0-9.0	weekly
	Chloroform	0.020 mg/L	annual
008 (FRENCH DRAIN WASTE WATER)	Flow	Monitor	3 per month
	BOD-5	**	3 per month
	Iron	**	3 per month
	pH (range)	6.0 - 9.0	3 per month
	Silver, total	0.008 mg/L	annual
	Zinc, total	0.100 mg/L	annual

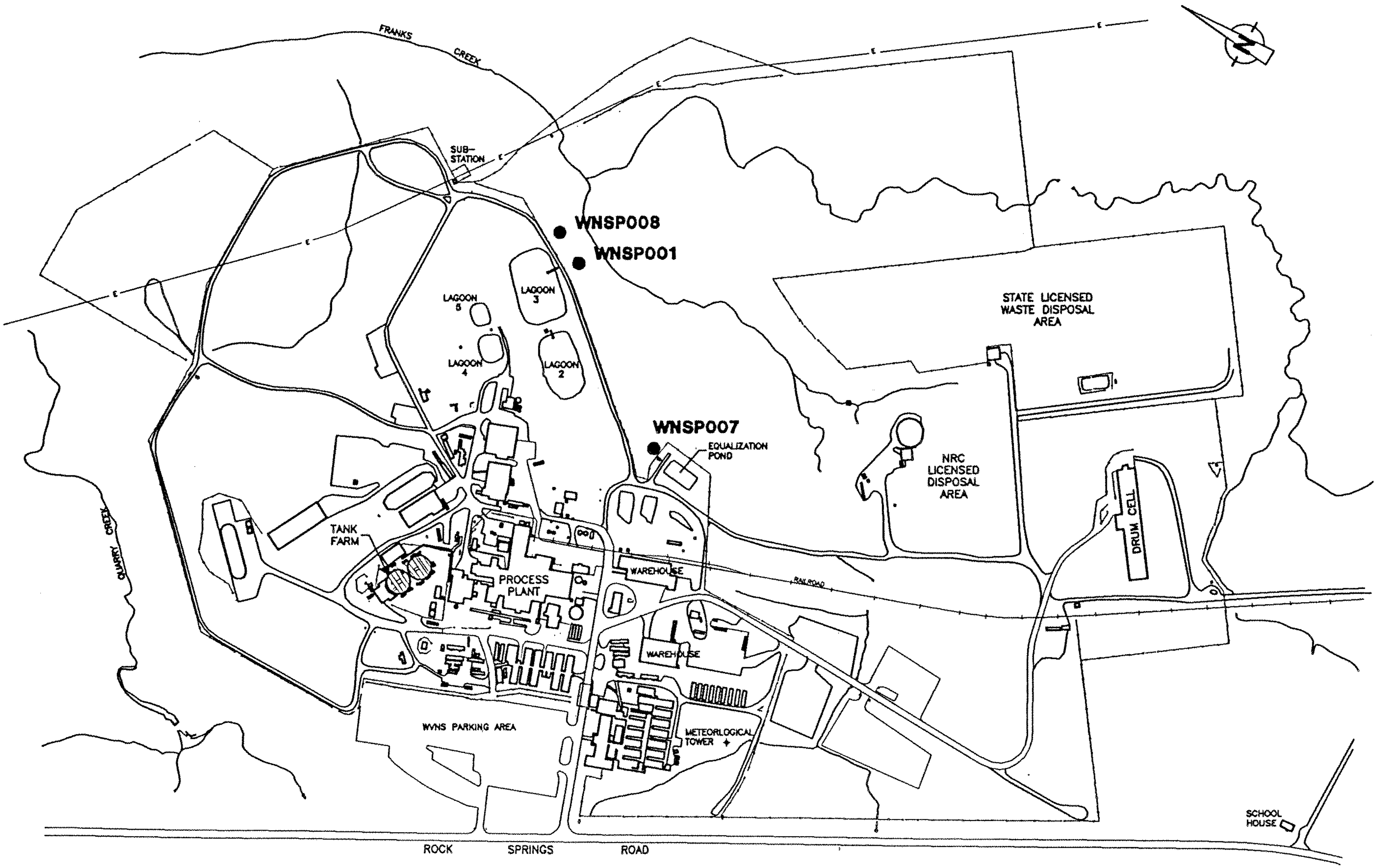
* Reported as flow-weighted average of outfalls 001 and 007. Limit is 2.1mg/L

** Reported as flow-weighted average of outfalls 001, 007, and 008. Limits are 5.0 mg/L for BOD-5 and 0.31 mg/L for Fe. Iron data are net limits reported after background concentrations are subtracted.

Table C - 5. 3

West Valley Demonstration Project 1989 SPDES Noncompliance Episodes

DATE	OUTFALL	Parameter	Limit	Value	Comments
JAN 89	007	Settleable Solids	0.3 ml/L	0.35 ml/L	Plugged sludge line
JAN 89	Sum 001, 007, 008	Fe	0.31 mg/L daily maximum	0.38 mg/L	Natural variation
JAN 89	007	Settleable Solids	0.3 ml/L	0.5 ml/L	Re-suspension
JAN 89	Sum 001, 007, 008	Fe	0.31 mg/L daily maximum	0.87 mg/L	Natural variation
MAR 89	007	pH	6.0 - 9.0	3.9	Incorrect acid pump setting
APR 89	007	pH	6.0 - 9.0	10.46	Incorrect acid pump setting
MAY 89	007	pH	6.0 - 9.0	11.0	Incorrect acid pump setting
JUN 89	007	pH	6.0 - 9.0	9.2, 5.6, 5. 6, 4. 0	4 occasions reported
JUL 89	007	pH	6.0 - 9.0	3.7, 3.1	2 occasions reported
JUL 89	Sum 001, 007, 008	BOD-5	5.0 mg/L daily average	6.85 mg/L	Attributed to algae
JUL 89	Sum 001, 007, 008	Fe	0.31 mg/L daily maximum	0.53, 2.82 mg/L	Natural variation
AUG 89	Sum 001, 007, 008	BOD-5	5.0 mg/L daily average	8.44 mg/L	Attributed to algae
AUG 89	Sum 001, 007, 008	Fe	0.31 mg/L daily maximum	2.39, 5.47, 1.38, 2. 41 mg/L	Natural variation
SEP 89	Sum 001, 007, 008	Fe	0.31 mg/L daily maximum	5.11, 1.59 mg/L	Natural variation
OCT 89	Sum 001, 007, 008	Fe	0.31 mg/L daily maximum	1.13, 1.22, 1.00, 1. 03 mg/L	Natural variation
DEC 89	007	Settleable Solids	0.3 ml/L	3, 1.2, 0. 5, 0.5 ml/L	Scouring of basin
DEC 89	Sum 001, 007, 008	BOD-5	5.0 mg/L daily average	9.27 mg/L	Related to above



WNSP001	LAGOON 3 DISCHARGE
WNSP007	SPDES 007 MIXING BASIN
WNSP008	DRAINS SUBSURFACE WATER FROM LLWT AREA (FRENCH DRAIN)

0 50 100 200 M
APPROX. SCALE

Figure C-5.1. SPDES Monitoring Points.

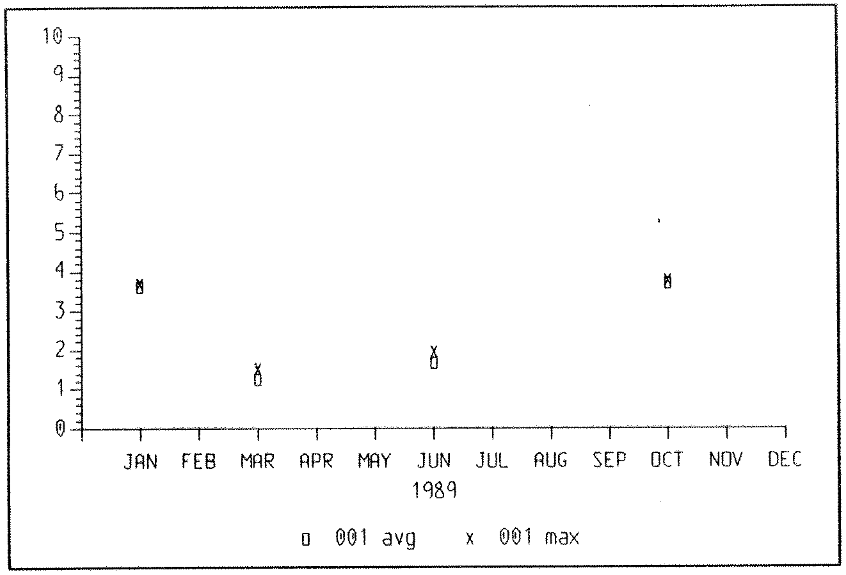


Figure C- 5. 2: Biochemical Oxygen Demand (mg/L), Outfall 001

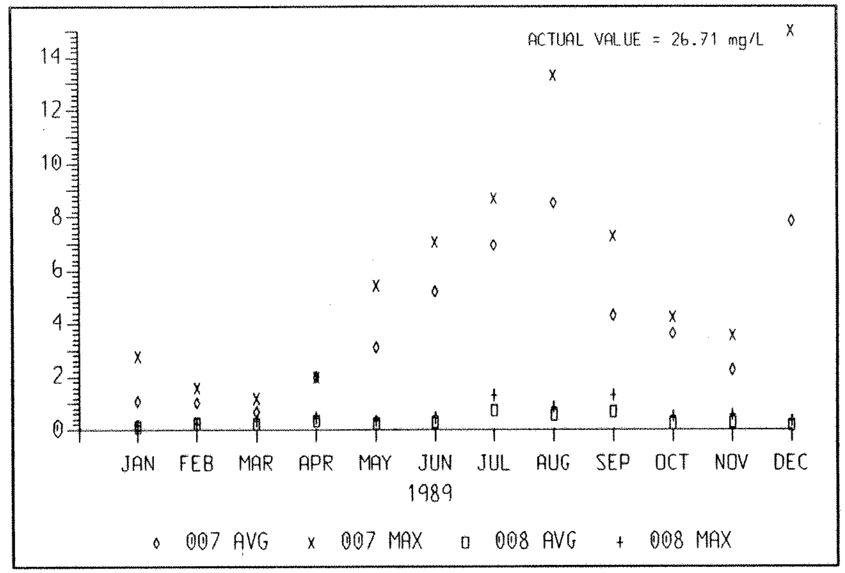


Figure C-5. 3: Biochemical Oxygen Demand (mg/L), Outfalls 007 and 008

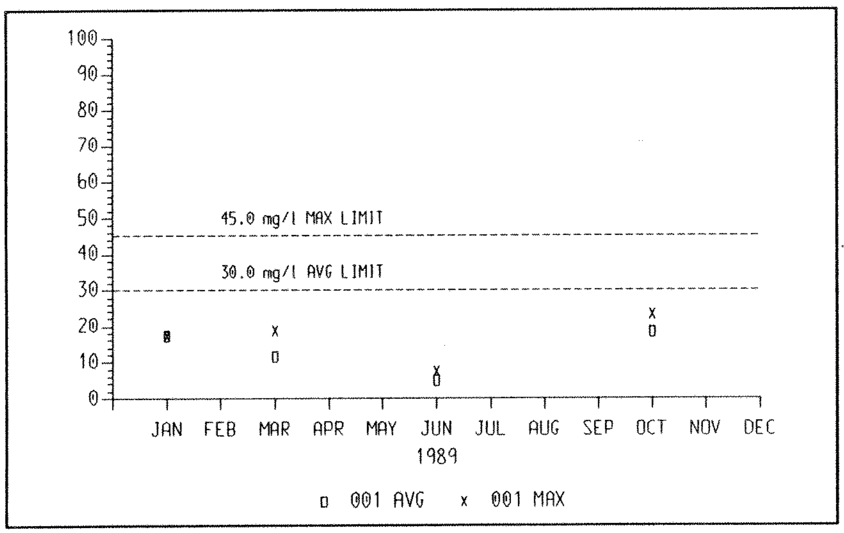


Figure C-5. 4: Suspended Solids (mg/L), Outfall 001

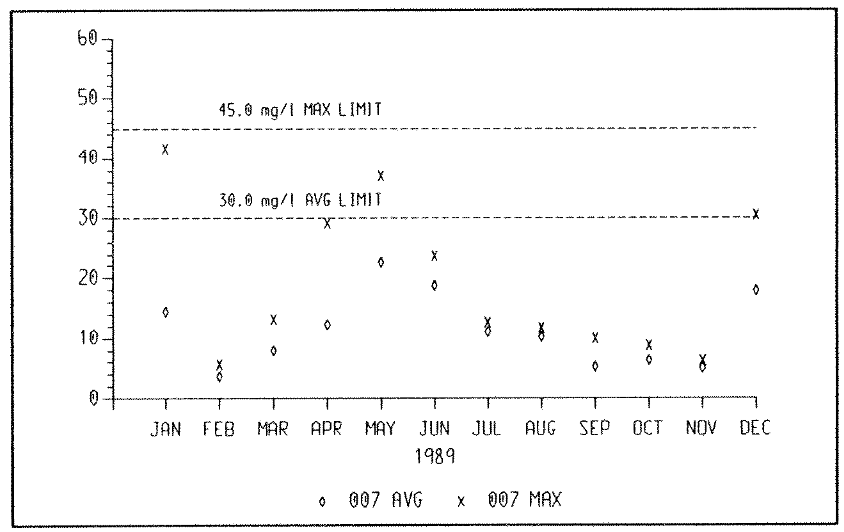


Figure C-5. 5: Suspended Solids (mg/L), Outfall 007

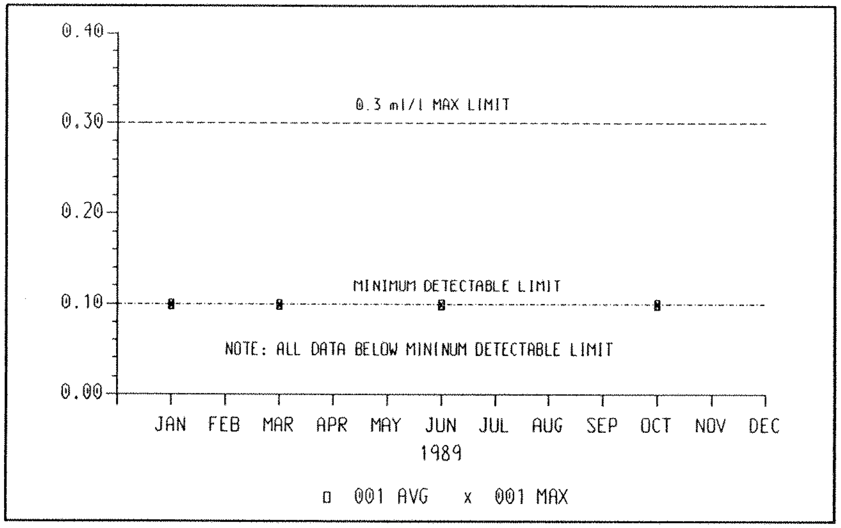


Figure C-5. 6: Settleable Solids (ml/L), Outfall 001

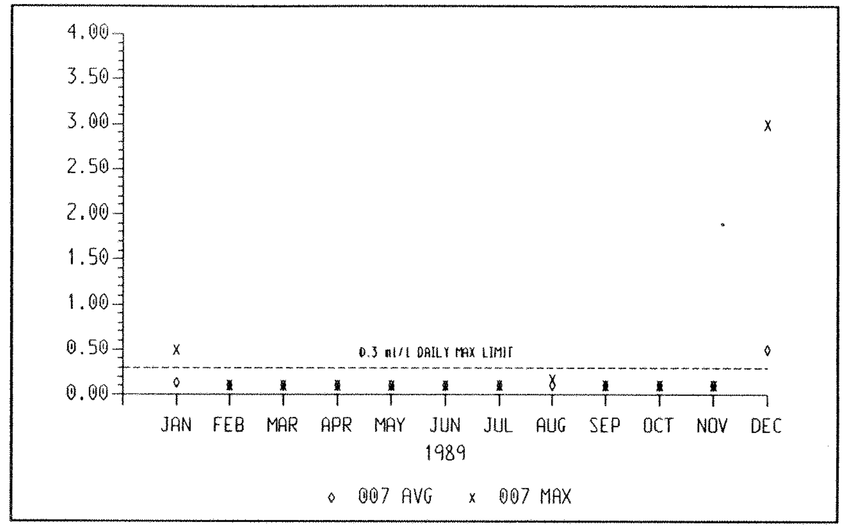


Figure C-5. 7: Settleable Solids (ml/L), Outfall 007

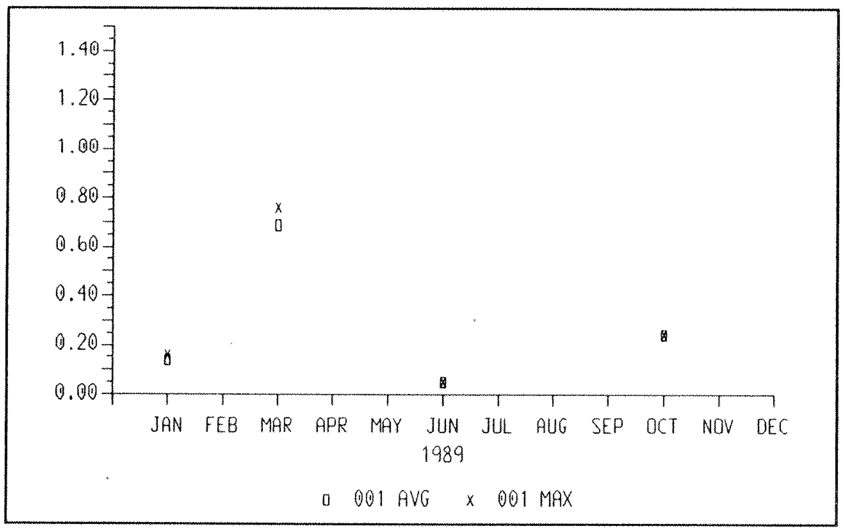


Figure C-5. 8: Ammonia (mg/L), Outfall 001

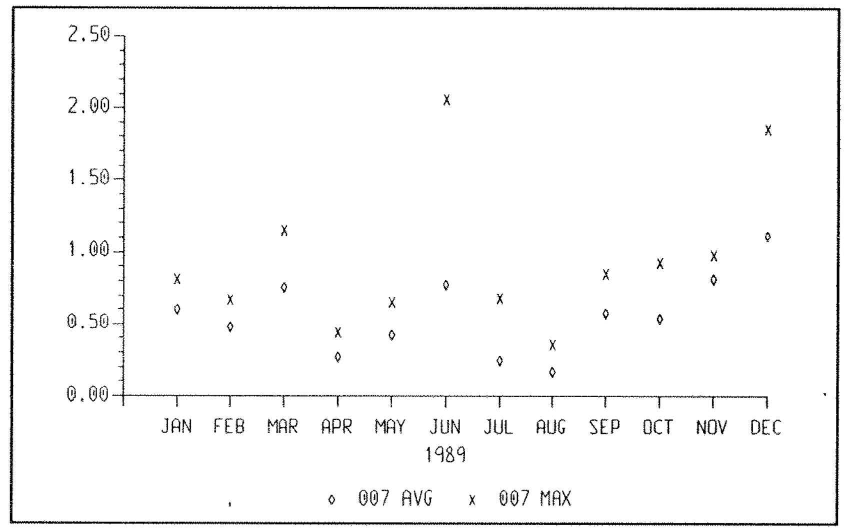


Figure C-5. 9: Ammonia (mg/L), Outfall 007

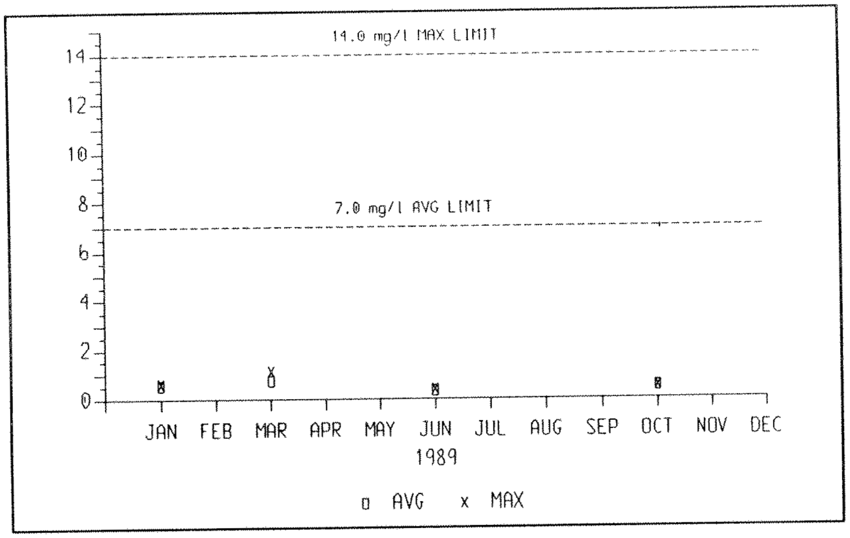


Figure C-5. 10: Aluminum (*Al*) (mg/L), Outfall 001

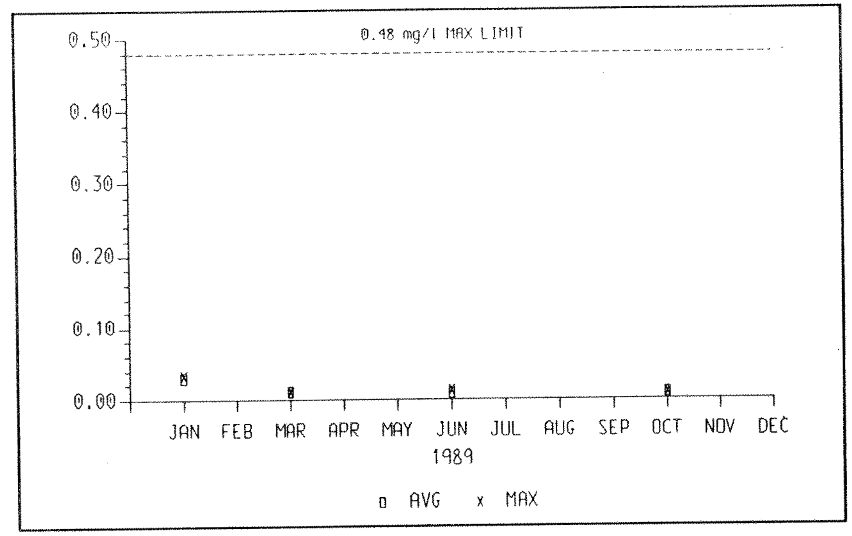


Figure C-5. 11: Zinc (*Zn*) (mg/L), Outfall 001

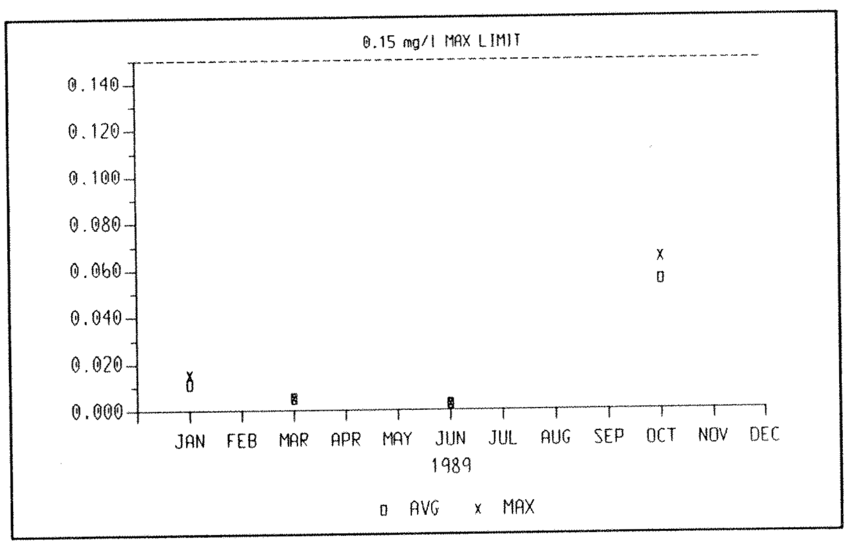


Figure C-5. 12: Arsenic (*As*) Dissolved (mg/L), Outfall 001

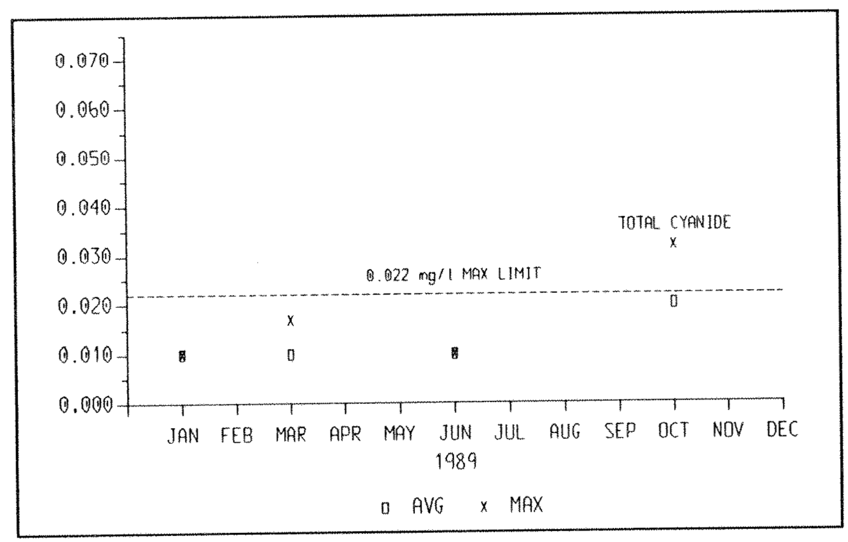


Figure C-5. 13: Cyanide Amenable to Chlorination (mg/L), Outfall 001

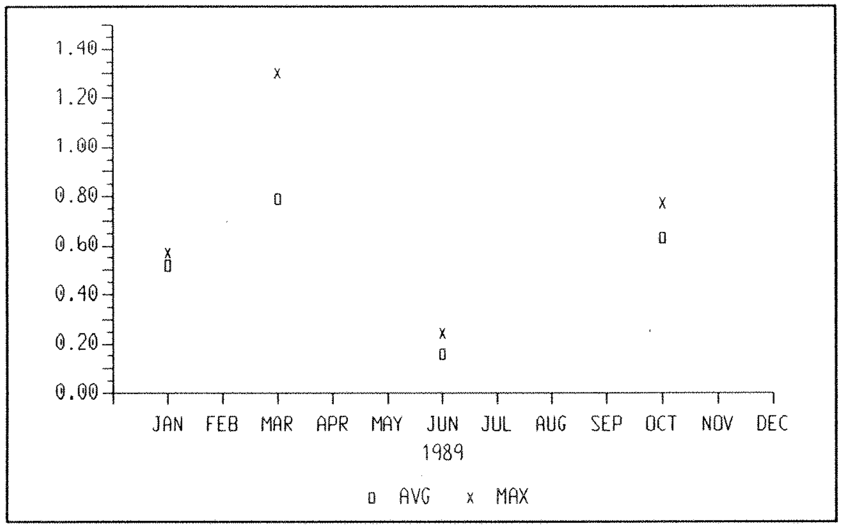


Figure C-5. 14: Iron (*Fe*) (mg/L), Outfall 001

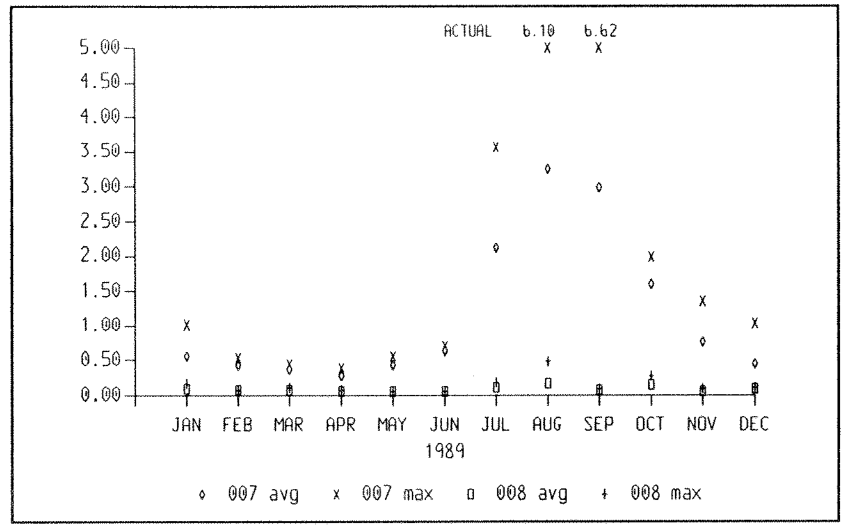


Figure C-5. 15: Iron (*Fe*) (mg/L) Outfalls 007 and 008

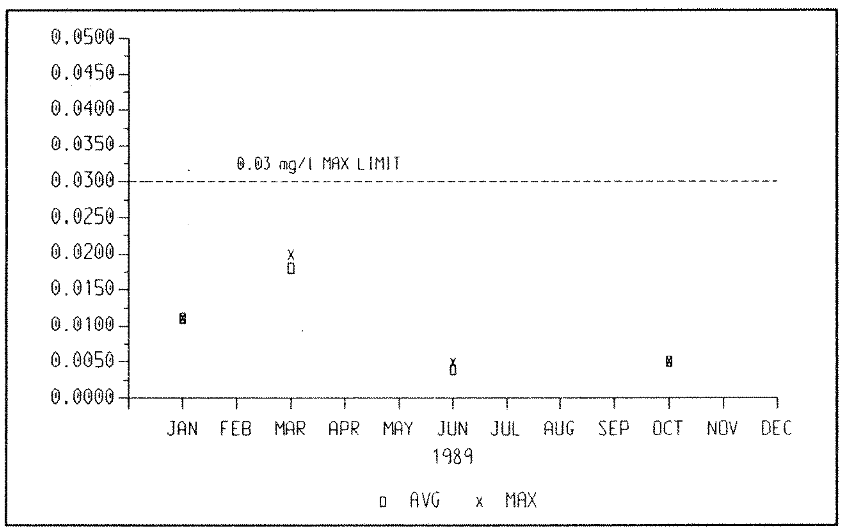


Figure C-5. 16: Copper (*Cu*) (mg/L), Outfall 001

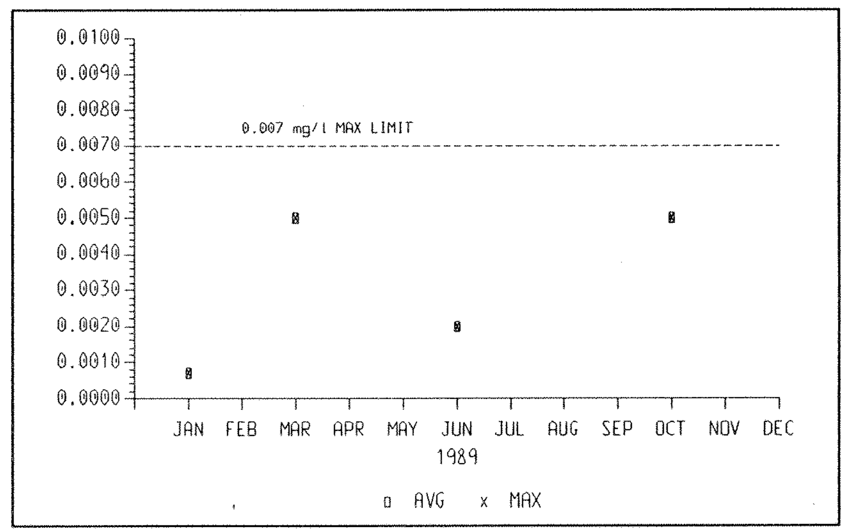


Figure C-5. 17: Cadmium (*Cd*) (mg/L), Outfall 001

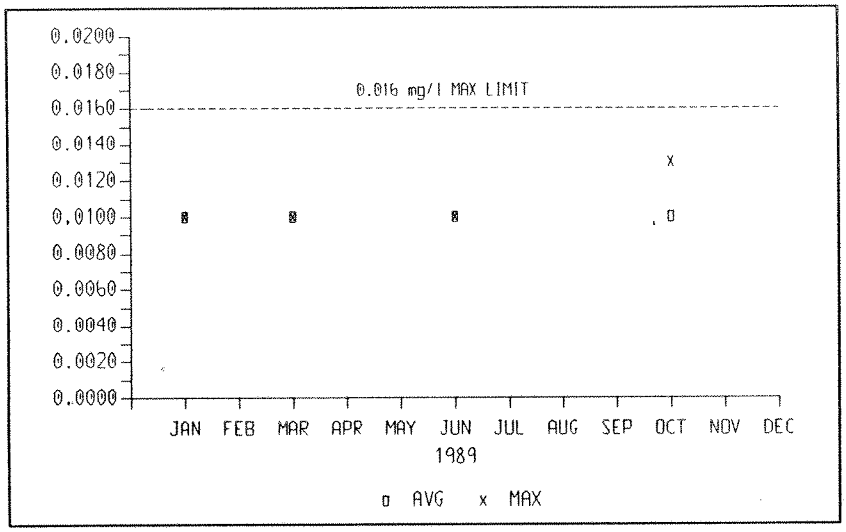


Figure C-5. 18: Chromium (*Cr,VI*) (mg/L), Outfall 001

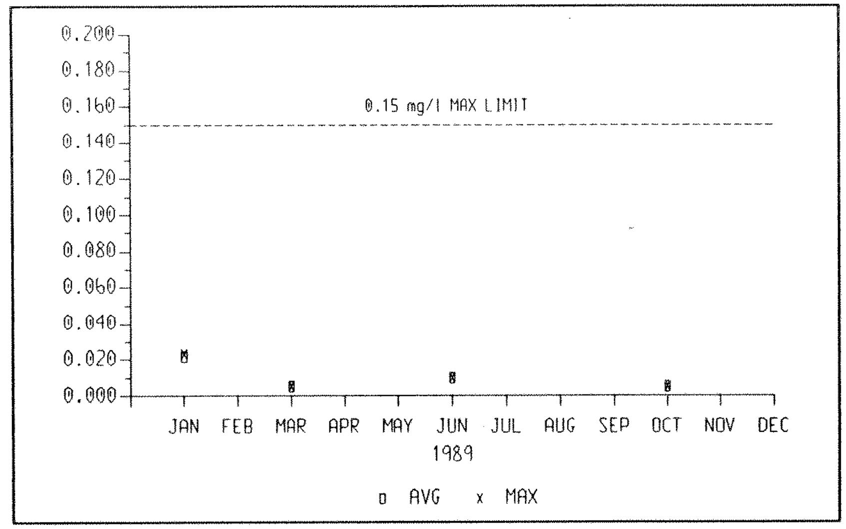


Figure C-5. 19: Lead(*Pb*)(mg/L), Outfall 001

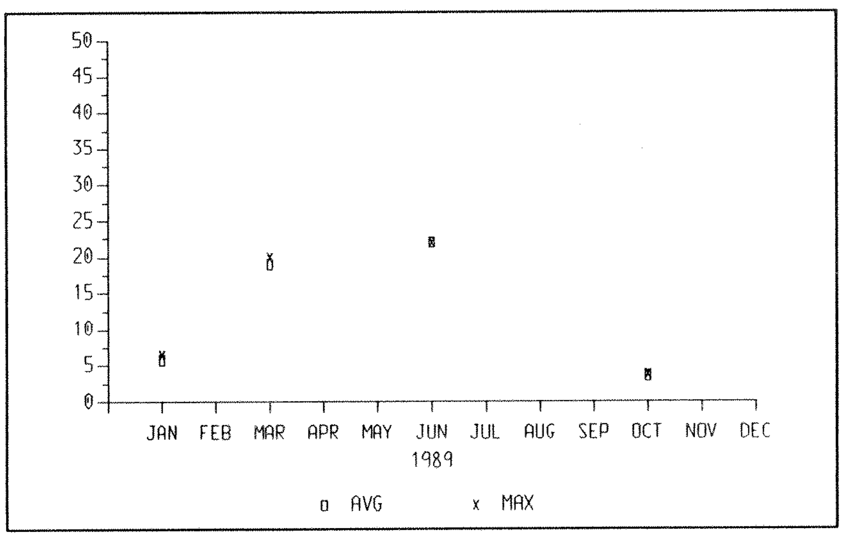


Figure C-5. 20: Nitrate (mg/L), Outfall 001

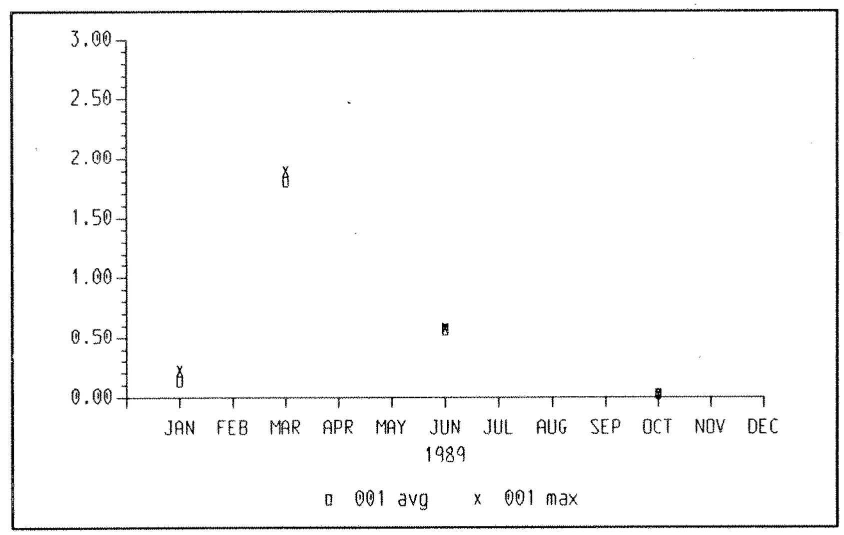


Figure C-5. 21: Nitrite (mg/L), Outfall 001

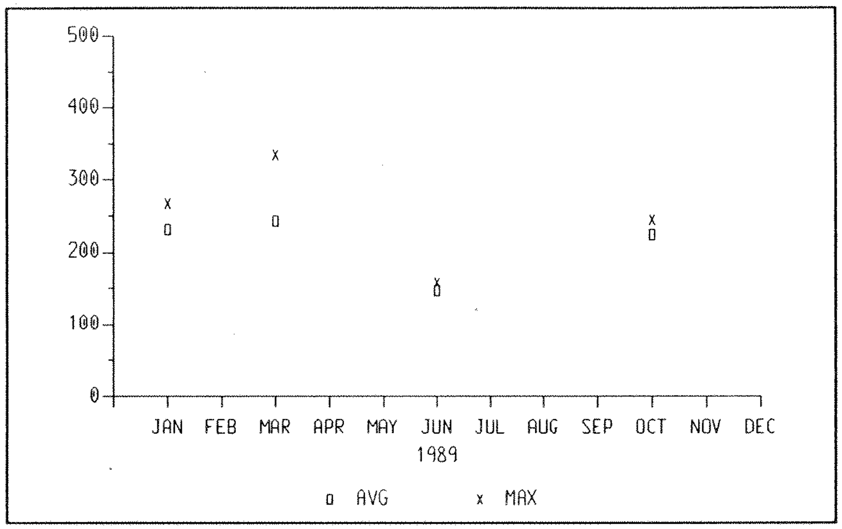


Figure C-5. 22: Sulfate (mg/L), Outfall 001

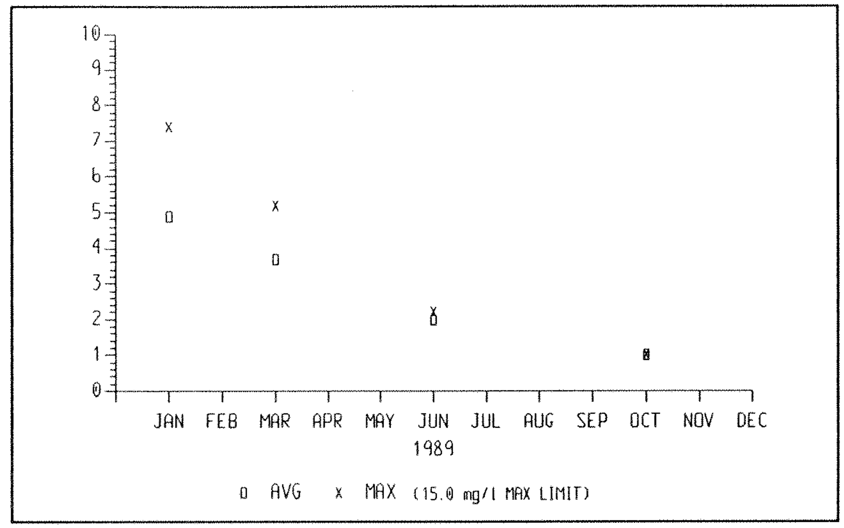


Figure C-5. 23: Oil and Grease (mg/L), Outfall 001

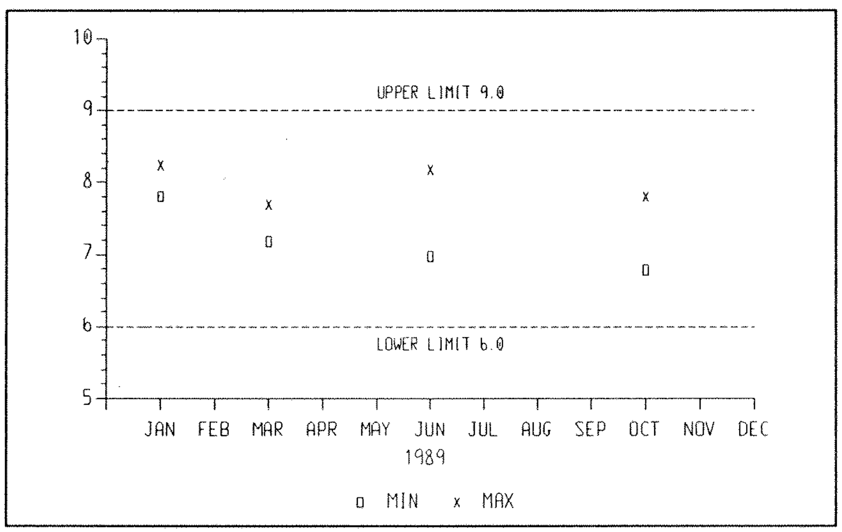


Figure C-5. 24: pH (standard units), Outfall 001

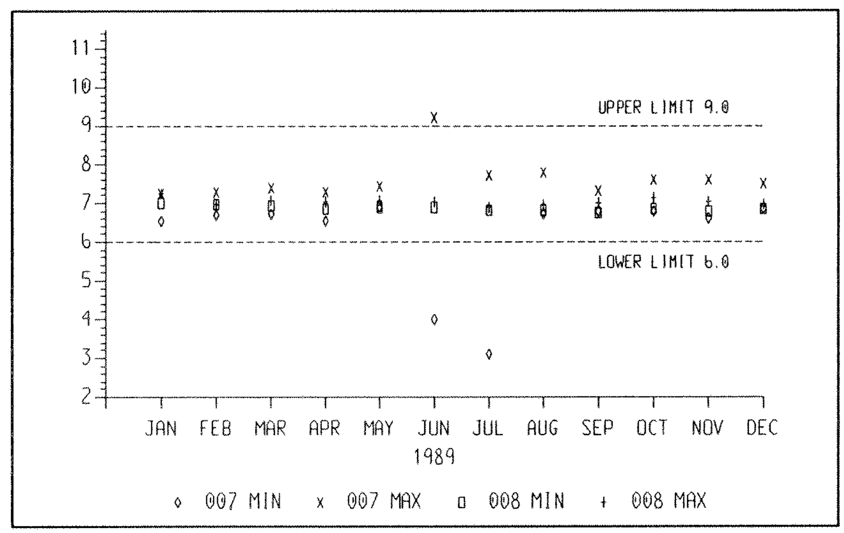


Figure C-5. 25: pH (standard units), Outfalls 007 and 008

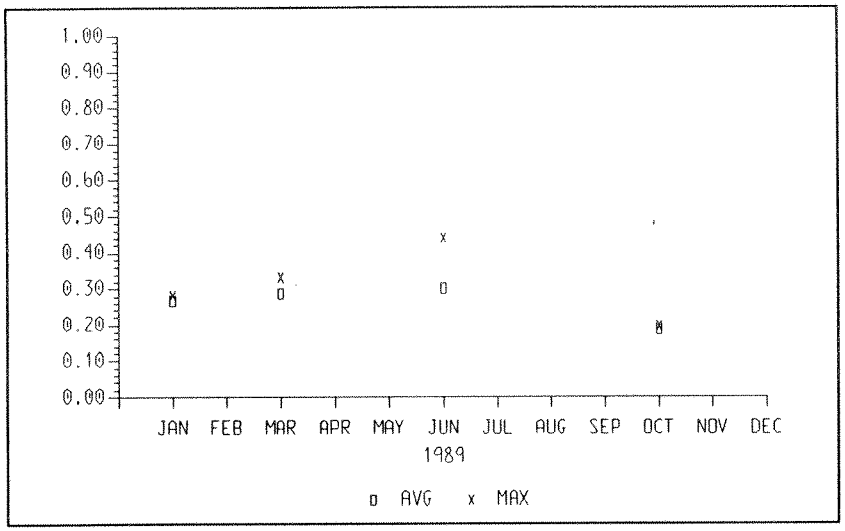


Figure C-5. 26: Discharge Rate (MGD), Outfall 001

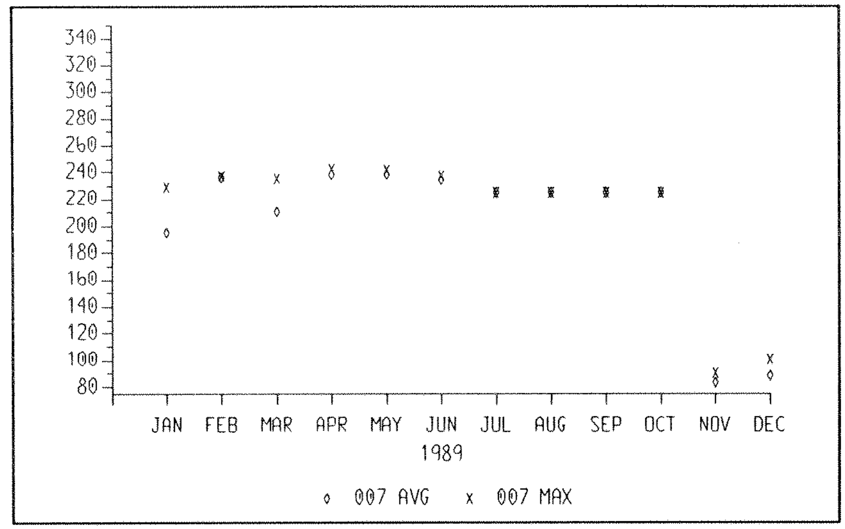


Figure C-5. 27: Discharge Rate (GPD x 1000), Outfall 007

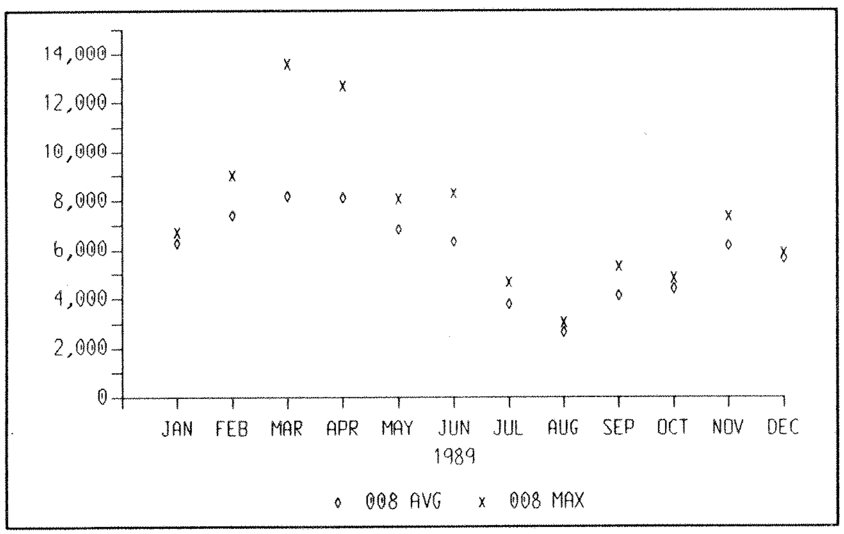


Figure C-5. 28: Discharge Rate (GPD), Outfall 008

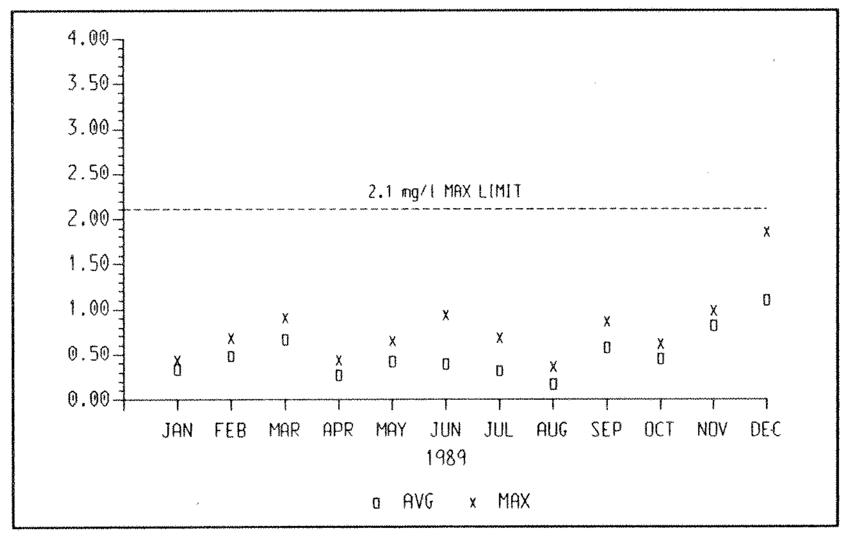


Figure C-5. 29: Flow-weighted Averages - Ammonia (mg/L), Outfalls 001 and 007

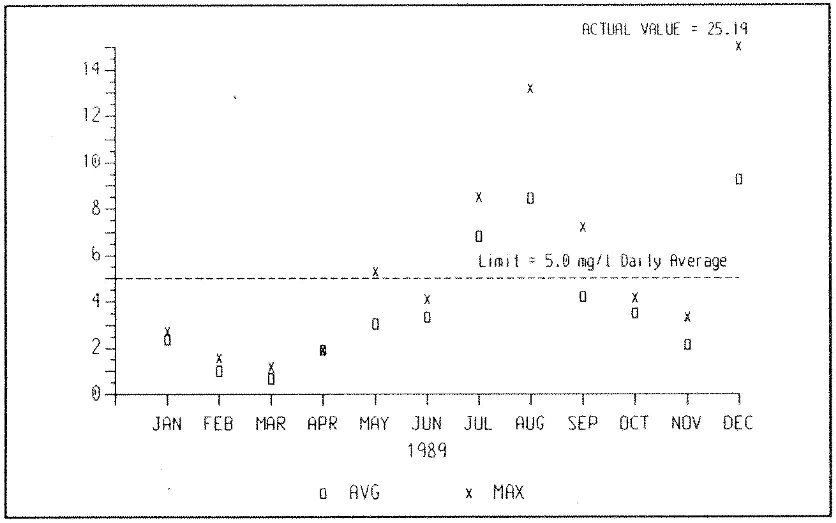


Figure C-5. 30: Flow-weighted Averages - Biochemical Oxygen Demand - 5 (mg/L), Outfalls 001, 007, and 008

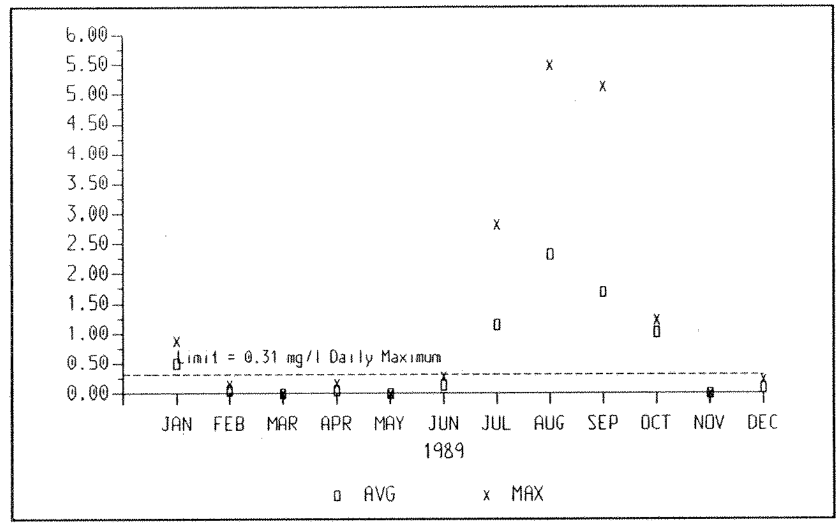


Figure C-5. 31: Flow-weighted Averages - Iron (Fe) (mg/L), Outfalls 001, 007, and 008

ANALYSIS OF WATER QUALITY SAMPLES IN THE ENVIRONMENTAL LABORATORY

APPENDIX D

SUMMARY OF QUALITY ASSURANCE CROSSCHECK ANALYSES

Table D - 1

Comparison of Radiological Concentrations in Quality Assurance Samples between the West Valley Demonstration Project and the Environmental Measurements Laboratory (EML) for QAP 8904 Samples

Units for air filters - pCi/filter; soil and vegetation - pCi/g; water - pCi/mL

Isotope	Sample	Actual	Reported	Ratio Rep/Act*	Accept
BE-7	AIR	1.95E+03	1.59E+03	0.82	YES
CO-60	AIR	1.26E+02	1.07E+02	0.85	YES
SR-90	AIR	2.39E+00	3.00E+00	1.26	PASS
CS-134	AIR	1.58E+02	1.48E+02	0.94	YES
CS-137	AIR	1.89E+02	1.72E+02	0.91	YES
CE-144	AIR	3.27E+02	2.75E+02	0.84	YES
PU-239	AIR	2.70E-01	3.00E-01	1.11	YES
AM-241	AIR	2.25E-01	3.00E-01	1.33	PASS
U-238	AIR	9.00E-02	3.00E-01	3.33	NO
K-40	SOIL	2.41E+01	1.89E+01	0.78	PASS
SR-90	SOIL	1.09E+00	8.00E-01	0.73	PASS
CS-137	SOIL	2.08E+01	1.62E+01	0.78	PASS
PU-239	SOIL	4.20E-01	4.00E-01	0.95	YES
AM-241	SOIL	2.10E-01	2.00E-01	0.95	YES
K-40	VEG	2.61E+01	2.27E+01	0.87	YES
SR-90	VEG	3.75E+00	3.60E+00	0.96	YES
CS-137	VEG	1.60E+00	1.20E+00	0.75	PASS
PU-239	VEG	2.20E-02	8.00E-02	3.64	NO
AM-241	VEG	1.50E-02	1.60E-02	1.07	YES
U-238	VEG	1.20E-02	2.40E-02	2.00	NO
H-3	WATER	6.31E+00	5.20E+00	0.82	YES
MN-54	WATER	3.00E-01	2.80E-01	0.93	YES
CO-57	WATER	8.80E-01	7.40E-01	0.84	YES
CO-60	WATER	9.40E-01	8.70E-01	0.93	YES
SR-90	WATER	5.50E-01	5.20E-01	0.95	YES
CS-134	WATER	2.73E+00	2.70E+00	0.99	YES
CS-137	WATER	2.55E+00	2.40E+00	0.94	YES
PU-239	WATER	5.90E-03	7.00E-03	1.19	YES
AM-241	WATER	4.50E-03	4.00E-03	0.89	YES
U-238	WATER	4.40E-03	5.00E-03	1.14	YES

* Ratio of reported to actual: 1.2-0.8 acceptable; 1.5-0.5 pass

Table D - 2

Comparison of Radiological Parameters in pCi/L in Quality Assurance Samples between the West Valley Demonstration Project and the U.S. EPA's Environmental Monitoring Systems Laboratory (EMSL) in 1989

Sample	Analyte	Matrix	Actual	Reported	Ratio Rep/Act*	Accept
8902 GAM	CO-60	WATER	1.00E+01	1.33E+01	1.33	YES
	CR-51	WATER	2.35E+02	2.10E+02	0.89	YES
	CS-134	WATER	1.00E+01	8.00E+00	0.80	YES
	CS-137	WATER	1.00E+01	1.30E+01	1.30	YES
	RU-106	WATER	1.78E+02	1.57E+02	0.88	YES
	ZN-65	WATER	1.59E+02	1.45E+02	0.91	YES
8902 TRW	H-3	WATER	2.75E+03	2.52E+03	0.92	YES
8903 AF	ALPHA	FILTER	2.10E+01	2.07E+01	0.99	YES
	BETA	FILTER	6.20E+01	6.60E+01	1.06	YES
8904 MILK	CS-137	MILK	5.00E+01	5.20E+01	1.04	YES
	K	MILK	1.60E+03	1.80E+03	1.12	YES
	SR-89	MILK	3.90E+01	2.53E+01	0.65	YES
	SR-90	MILK	5.50E+01	5.40E+01	0.98	YES
8904 PE	ALPHA	WATER	2.90E+01	1.97E+01	0.68	YES
	BETA	WATER	5.70E+01	4.87E+01	0.85	YES
	CS-134	WATER	2.00E+01	2.13E+01	1.06	YES
	CS-137	WATER	2.00E+01	2.20E+01	1.10	YES
	RA-226	WATER	3.50E+00	N.R.	N/A	N/A
	RA-228	WATER	3.60E+00	N.R.	N/A	N/A
	SR-89	WATER	8.00E+00	N.R.	N/A	N/A
	SR-90	WATER	8.00E+00	N.R.	N/A	N/A
	U	WATER	3.00E+00	N.R.	N/A	N/A
8905 ABW	ALPHA	WATER	3.00E+01	2.40E+01	0.80	YES
	BETA	WATER	5.00E+01	6.23E+01	1.25	NO
8906 GAM	BA-133	WATER	4.90E+01	2.83E+01	0.58	NO
	CO-60	WATER	3.10E+01	2.60E+01	0.84	YES
	CS-134	WATER	3.90E+01	3.57E+01	0.92	YES
	CS-137	WATER	2.00E+01	2.50E+01	1.25	YES
	RU-106	WATER	1.28E+02	8.83E+01	0.69	YES
	ZN-65	WATER	1.65E+02	1.44E+02	0.87	YES
	H-3	WATER	4.50E+03	3.99E+03	0.89	YES

Explanation of Codes: GAM - Gamma in water or soil; TRW - Tritium in water; AF - Air Filter; PE - Performance Evaluation; ABW - Alpha and beta in water; PUW - Plutonium in water; N/A - Not applicable; NR - Not reported

Comparison of Radiological Parameters in Quality Assurance Samples between the West Valley Demonstration Project and the U.S. EPA's Environmental Monitoring Systems Laboratory (EMSL) in 1989

Sample	Analyte	Matrix	Actual	Reported	Ratio Rep/Act*	Accept
8908 AF	ALPHA	FILTER	6.00E+00	6.00E+00	1.00	YES
	CS-137	FILTER	1.00E+01	1.23E+01	1.23	YES
8908 PUW	PU-239	WATER	2.80E+00	2.83E+00	1.01	YES
8910 PE	ALPHA	WATER	3.67E+01	4.90E+01	1.34	YES
	BETA	WATER	3.27E+01	3.20E+01	0.98	YES
	CS-134	WATER	8.33E+00	5.00E+00	0.60	YES
	CS-137	WATER	9.33E+00	5.00E+00	0.54	YES
	RA-226	WATER	1.72E+01	8.40E+00	0.49	NO
	RA-228	WATER	2.80E+00	4.10E+00	1.46	NO
	SR-89	WATER	1.53E+01	1.50E+01	0.98	YES
	SR-90	WATER	7.00E+01	7.00E+00	1.00	YES
	U	WATER	1.20E+01	1.20E+01	1.00	YES

Samples are identified by the sampling period during the year, the element(s) being measured, and the media. For example, the first sample listed above, 8902 GAM, means that gamma in water or soil was sampled during the second sampling period of 1989. "Water" is listed as the matrix, indicating that gamma in water rather than in soil was measured. The sample listed as 8905 ABW means that alpha and beta measurements in water were taken during the fifth sampling period of 1989.

***Ratio of Reported to Actual: Acceptable range determined by the United States Environmental Protection Agency's Environmental Monitoring Systems Laboratory (USEPA - EMSL).**

Explanation of Codes: GAM - Gamma in water or soil; TRW - Tritium in water; AF - Air Filter; PE - Performance Evaluation; ABW - Alpha and beta in water; PUW - Plutonium in water; N/A - Not applicable; NR - Not reported

Table D - 3

Comparison of Radiological Concentrations (μCi/sample) in Quality Assurance Samples between the West Valley Demonstration Project and the National Institute of Standards and Technology (NIST) for 1989 Idaho National Engineering Laboratory (INEL) Quality Assurance Samples

Sample	Isotopes	NIST Measured	WVDP Reported	Ratio WV/NIST	Accept*
WATER	CO-57	4.14E-02	3.84E-02	0.93	YES
	CO-60	5.54E-02	5.37E-02	0.97	YES
	CS-137	7.18E-02	7.54E-02	1.05	YES

* Acceptable range determined by INEL

Table D - 4

Comparison of Water Quality Parameters in Quality Assurance Samples between the West Valley Demonstration Project and the New York State Department of Health (NYSDOH), January 1989

Units for metals (Ag, Al, As, Cd, Cr, Cu, Fe, Ni, Pb, Se, Zn) are μg/L. Units for BOD, CN, NH3, Oil and Grease, Total Suspended Solids are mg/L

Analyte	Matrix	Known	WVDP Data	Reported/Actual	Accept*
AG	WATER	1.83E+02	1.76E+02	0.96	YES
AG	WATER	5.01E+02	4.91E+02	0.98	YES
AL	WATER	2.04E+02	2.10E+02	1.03	YES
AL	WATER	4.71E+02	4.37E+02	0.93	YES
AS	WATER	4.41E+02	4.14E+02	0.94	YES
AS	WATER	1.78E+02	1.80E+02	1.01	YES
BOD	WATER	9.02E+01	9.96E+01	1.10	YES
BOD	WATER	5.34E+01	5.99E+01	1.12	YES
CD	WATER	4.99E+01	4.90E+01	0.98	YES
CD	WATER	8.45E+01	8.42E+01	1.00	YES
CN	WATER	2.21E+00	2.24E+00	1.01	YES
CN	WATER	1.38E+00	1.27E+00	0.92	YES
CR	WATER	2.15E+02	2.17E+02	1.01	YES
CR	WATER	3.85E+02	3.56E+02	0.92	YES
CU	WATER	1.35E+02	1.28E+02	0.95	YES
CU	WATER	2.85E+02	2.81E+02	0.99	YES
FE	WATER	5.17E+02	5.26E+02	1.02	YES
FE	WATER	2.37E+02	2.27E+02	0.96	YES
NH3	WATER	1.47E+00	1.43E+00	0.97	YES
NH3	WATER	3.94E+00	3.90E+00	0.99	YES
NI	WATER	3.40E+02	3.36E+02	0.99	YES
NI	WATER	2.36E+02	2.33E+02	0.99	YES
OIL	WATER	1.67E+02	1.69E+02	1.01	YES
OIL	WATER	7.82E+01	8.08E+01	1.03	YES
PB	WATER	1.65E+02	1.66E+02	1.01	YES
PB	WATER	3.50E+02	3.51E+02	1.00	YES
PH	WATER	4.51	4.48	0.99	YES
PH	WATER	9.15	9.20	1.01	YES
SE	WATER	1.17E+02	1.14E+02	0.97	YES
SE	WATER	1.66E+02	1.17E+02	0.70	YES
TOT SUSP	WATER	6.57E+01	6.71E+01	1.02	YES
TOT SUSP	WATER	2.58E+01	2.66E+01	1.03	YES
ZN	WATER	7.96E+02	7.72E+02	0.97	YES
ZN	WATER	1.66E+03	1.64E+03	0.99	YES

* Acceptable range determined by NYSDOH

Table D - 5

Comparison of Water Quality Parameters in Quality Assurance Samples between the West Valley Demonstration Project and the New York State Department of Health (NYSDOH), July 1989

Units for metals (Ag, Al, As, Cd, Cr, Cu, Fe, Ni, Pb, Se, Zn) are μg/L; units for BOD, CN, NH3, Oil, Total Suspended Solids are mg/L

Analyte	Matrix	Known	WVNS Data	Reported/Actual	Accept
AG	WATER	3.25E+02	3.45E+02	1.06	YES
AG	WATER	1.75E+02	2.04E+02	1.17	NO
AL	WATER	2.21E+02	2.52E+02	1.14	YES
AL	WATER	4.18E+02	4.21E+02	1.01	YES
AS	WATER	4.13E+02	4.25E+02	1.03	YES
AS	WATER	1.71E+02	1.75E+02	1.02	YES
BOD	WATER	3.02E+01	3.36E+01	1.11	YES
BOD	WATER	6.85E+01	7.26E+01	1.06	YES
CD	WATER	3.79E+01	4.00E+01	1.06	YES
CD	WATER	9.59E+01	1.02E+02	1.06	YES
CN	WATER	1.48E+00	1.39E+00	0.94	YES
CN	WATER	2.76E+00	2.62E+00	0.95	YES
CR	WATER	1.89E+02	1.84E+02	0.97	YES
CR	WATER	4.66E+02	4.40E+02	0.94	YES
CU	WATER	4.77E+02	4.99E+02	1.05	YES
CU	WATER	2.01E+02	2.10E+02	1.04	YES
FE	WATER	2.66E+02	2.48E+02	0.93	YES
FE	WATER	4.82E+02	2.63E+02	0.55	NO
NH3	WATER	2.67E+00	2.50E+00	0.94	YES
NH3	WATER	1.69E+00	1.57E+00	0.93	YES
NI	WATER	2.80E+02	2.97E+02	1.06	YES
NI	WATER	4.93E+02	5.27E+02	1.07	YES
OIL	WATER	6.11E+01	7.30E+01	1.19	PASS
OIL	WATER	1.07E+02	1.24E+02	1.16	PASS
PB	WATER	3.50E+02	3.65E+02	1.04	YES
PB	WATER	1.75E+02	1.72E+02	0.98	YES
PH	WATER	8.32	8.39	1.01	YES
PH	WATER	6.07	6.09	1.00	YES
SE	WATER	1.08E+02	1.17E+02	1.08	YES
SE	WATER	1.89E+02	2.05E+02	1.08	YES
TOT SUSP	WATER	9.73E+01	1.01E+02	1.04	YES
TOT SUSP	WATER	5.82E+01	6.00E+01	1.03	YES
ZN	WATER	4.57E+03	4.96E+03	1.09	YES
ZN	WATER	1.51E+03	1.64E+03	1.09	YES

Table D - 6

Thermoluminescent Dosimetry (TLDs): Comparison of the WVDP TLDs to the Co-located NRC TLDs

First Quarter

NRC TLD #	WVDP TLD #	μR/hr NRC	μR/hr WVDP	WVDP/NRC	ACCEPT*
2	22	6.9	8.7	1.26	PASS
3	5	7.1	8.8	1.24	PASS
4	7	6.2	8.3	1.34	PASS
5	9	7.6	8.4	1.11	YES
7	14	7.5	9.2	1.23	PASS
8	15	7.7	8.8	1.14	YES
9	25	15.0	15.8	1.05	YES
11	24	632.9	715.6	1.13	YES

Second Quarter

NRC TLD #	WVDP TLD #	μR/hr NRC	μR/hr WVDP	WVDP/NRC	ACCEPT
2	22	8.7	7.8	0.90	YES
3	5	10.3	8.6	0.83	YES
4	7	7.6	7.7	1.01	YES
5	9	9.8	7.9	0.81	YES
7	14	8.8	8.2	0.93	YES
8	15	8.5	MISSING	N.A.	N.A.
9	25	17.8	14.8	0.83	YES
11	24	559.7	628.4	1.12	YES

Third Quarter

NRC TLD #	WVDP TLD #	μR/hr NRC	μR/hr WVDP	WVDP/NRC	ACCEPT
2	22	7.9	10.5	1.33	PASS
3	5	8.8	10.3	1.17	YES
4	7	7.3	9.3	1.27	PASS
5	9	9.2	9.2	1.00	YES
7	14	9.2	10.6	1.15	YES
8	15	9.0	10.0	1.11	YES
9	25	17.2	17.8	1.03	YES
11	24	550.9	662.8	1.20	PASS

Fourth Quarter

NRC TLD #	WVDP TLD #	μR/hr NRC	μR/hr WVDP	WVDP/NRC	ACCEPT
2	22	5.9	8.0	1.36	PASS
3	5	MISSING	9.0	N.A.	N.A.
4	7	5.5	7.7	1.40	PASS
5	9	7.8	8.1	1.04	YES
7	14	MISSING	8.7	N.A.	N.A.
8	15	5.5	8.6	1.56	NO
9	25	15.4	14.6	0.95	YES
11	24	725.0	670.6	0.92	YES

* Ratio: 1.2 - 0. 8 acceptable; 1.5 - 0.5 pass N.A. Not available

COLLECTING A GROUNDWATER SAMPLE

APPENDIX E

SUMMARY OF GROUNDWATER MONITORING

Table E-1

Supporting Groundwater Monitoring Stations Sampled During 1989 (μCi/mL)

Location Code	Date Sampled	pH	Conductivity *	Alpha	Beta	H-3	Cs-137	Co-60
				Wells Near Site Facilties				
WNW80-03	06/23/89	6.79	651	<1.63E-09	2.25E-07 ± 8.85E-09	<1.24E-07	<1.1E-08	<1.4E-08
WNW80-03	12/19/89	7.48	514	<2.34E-09	2.49E-07 ± 1.14E-08	1.41E-07 ± 1.09E-07	<3.7E-08	<3.8E-08
WNW80-04	06/23/89	6.97	611	<4.39E-09	2.50E-08 ±3.33E-09	1.80E-07 ±1.19E-07	<1.1E-08	<1.4E-08
WNW80-04	12/19/89	7.26	604	<1.91E-09	1.62E-08 ± 3.04E-09	3.23E-07 ± 1.16E-07	<3.7E-08	<3.8E-08
				Wells Near NRC Disposal Unit				
WNW82-1A	06/23/89	7.03	1353	2.35E-08 ±2.05E-08	7.69E-09 ±2.37E-09	2.32E-07 ± 1.21E-07	<1.1E-08	<1.4E-08
WNW82-1A	12/19/89	7.37	1369	2.92E-08 ± 1.66E-08	1.18E-08 ± 4.63E-09	5.43E-07 ± 1.14E-07	<3.7E-08	<3.8E-08
WNW82-1B	06/23/89	7.10	1380	<1.73E-09	1.64E-08 ± 4.80E-09	<1.17E-07	<1.1E-08	<1.4E-08
WNW82-1B	12/19/89	7.26	1329	<6.89E-09	1.01E-08± 2.85E-09	4.02E-07 ± 1.10E-07	<3.7E-08	<3.8E-08
WNW82-1C	06/28/89	7.43	395	<5.17E-09	4.22E-09 ± 1.91E-09	<1.0E-07	<1.1E-08	<1.4E-08
WNW82-1C	12/20/89	7.99	NA	<1.41E-09	<3.53E-09	2.18E-07 ± 1.10E-07	<3.7E-08	<3.8E-08
WNW82-2B	06/28/89	7.10	752	1.16E-08 ± 8.62E-09	1.21E-08 ± 3.52E-09	<1.0E-07	<1.1E-08	<1.4E-08
WNW82-2B	12/20/89	7.39	743	<5.00E-09	9.98E-09 ± 3.30E-09	1.83E-07 ± 1.09E-07	<3.7E-08	<3.8E-08
WNW82-2C	06/28/89	9.00	688	3.88E-08 ± 2.54E-08	2.97E-08 ± 5.93E-09	<1.0E-07	<1.1E-08	<1.4E-08
WNW82-2C	12/20/89		***NOT AVAILABLE***					
WNW82-3A	06/23/89	7.56	288	1.37E-08 ± 8.52E-09	1.43E-08 ± 2.66E-09	<1.0E-07	<1.1E-08	<1.4E-08
WNW82-3A	12/20/89		***NOT AVAILABLE***					
WNW82-4A1	06/23/89	6.58	1428	<6.83E-09	8.76E-09 ± 4.14E-09	6.81E-05 ± 2.06E-06	<1.1E-08	<1.4E-08
WNW82-4A1	12/20/89	6.81	1421	1.60E-08 ± 1.40E-08	9.37E-09 ± 4.44E-09	5.61E-05 ± 1.70E-06	<3.7E-08	<3.8E-08
WNW82-4A2	06/23/89	6.78	1509	<1.60E-08	1.11E-08 ± 5.02E-09	1.52E-07 ± 1.18E-07	<1.1E-08	<1.4E-08
WNW82-4A2	12/20/89	6.95	1470	<6.23E-09	4.63E-09 ± 3.80E-09	3.25E-07 ± 1.14E-07	<3.7E-08	<3.8E-08
WNW82-4A3	06/23/89	6.73	1382	<5.44E-09	3.72E-09 ± 3.60E-09	1.84E-07± 1.19E-07	<1.1E-08	<1.4E-08
WNW82-4A3	12/20/89	6.92	1430	<6.61E-09	6.64E-09 ± 4.25E-09	4.08E-07 ± 1.18E-07	<3.7E-08	<3.8E-08

* Measured in μmhos/cm @25°C

Table E - 2

1989 Fuel Tank Groundwater Monitoring

Parameter	WNW86-13 (Sample date: 6-19-89)	WNW86-13 (Sample date: 10-10-89)	WNW86-13 (Sample date: 11-20-89)*
pH	6.89	6.88	
Conductivity (μmhos/cm @25°C)	614	696	
TOC (mg/L)	2.3	2.8	
Phenols (mg/L)	< 0.007	< 0.008	
Benzene (μg/L)	0.2	< 0.2	< 0.4
Toluene (μg/L)	0.51	0.36	< 0.4
o-xylene (μg/L)	< 0.2	< 1	< 1
m-xylene (μg/L)	< 0.2	< 1	< 1
p-xylene (μg/L)	< 0.2	< 0.4	< 1
H-3 (μCi/mL)	< 1.0E-07	< 1.0E-07	
Alpha (μCi/mL)	< 2.7E-09	< 3.48E-09	
Beta (μCi/mL)	4.54±1.65E-09	4.40±1.70E-09	

* Sample collected 11-20-89 analyzed for volatile compounds only

Table E - 3

1989 Water Quality Parameters for the High-Level Waste Tank Complex Groundwater Monitoring Unit (mg/L)

Location Code	Hydraulic Position	Sample Date	pH	Conductivity**	TOC	Phenols	TOX	Chloride	Nitrate-N	Sulfate	Fluoride
*** QUALITY STANDARDS ***			6.5-8.5	N/A	N/A	.001	N/A	250	10	250	1.5
WNW80-02	UP	05/24/89	7.77	429	< 1.0	.006	<.010	52	.90	50	<.10
WNW80-02	UP	06/12/89	7.69	433	< 1.0	<.007	.028	54	.33	16	<.10
WNW80-02	UP	06/19/89	7.65	432	< 1.0	<.007	.011	52	.50	17	<.10
WNW80-02	UP	06/26/89	7.56	442	< 1.0	<.007	<.010	55	.54	26	<.10
WNW80-02	UP	09/07/89	7.68	403	< 1.0	<.007	.012	50	.62	13	<.10
WNW80-02	UP	10/23/89	7.81	404	< 1.0	<.008	<.010	48	.48	18	<.10
WNW80-02	UP	12/14/89	7.85	394	< 1.0	<.008	<.005	40	.35	16	<.10
WNW80-02	UP	12/14/89	7.87	402	< 1.0	<.008	.005	44	.37	14	<.10
WNDMPNE *	DOWN	06/09/89	6.66	641	8.0	<.020	.012	66	.80	49	<.10
WNDMPNE	DOWN	06/14/89	6.64	577	4.7	<.020	.010	52	.84	58	<.10
WNDMPNE	DOWN	06/22/89	6.50	499	5.2	.014	.012	29	.52	46	<.10
WNDMPNE	DOWN	06/28/89	6.68	641	4.2	<.007	<.010	64	1.10	38	<.10
WNDMPNE	DOWN	09/26/89	7.40	712	4.8	<.006	<.010	88	0.64	95	<.10
WNDMPNE	DOWN	11/13/89	6.79	637	4.0	<.020	N/A	58	.80	56	<.10
WNDMPNE	DOWN	12/19/89	6.98	644	5.3	<.008	.010	61	1.10	57	<.10
WNDMPNE	DOWN	12/19/89	6.96	651	1.8	<.008	<.010	64	1.20	60	<.10
WNW86-07	DOWN	06/06/89	6.69	721	1.2	<.005	<.100	15	1.20	140	<.10
WNW86-07	DOWN	06/14/89	6.27	655	< 1.0	<.007	.017	14	1.30	140	<.10
WNW86-07	DOWN	06/21/89	6.23	694	< 1.0	.025	<.010	14	1.10	62	<.10
WNW86-07	DOWN	06/26/89	6.27	667	< 1.0	<.007	.022	14	.99	140	<.10
WNW86-07	DOWN	09/07/89	6.83	809	< 1.0	<.007	<.010	6.6	1.10	160	<.10
WNW86-07	DOWN	10/26/89	6.17	711	2.1	<.008	.016	13	1.10	190	<.10
WNW86-07	DOWN	12/12/89	6.11	726	8.6	<.020	.008	19	1.00	180	<.10
WNW86-07	DOWN	12/12/89	6.05	697	3.2	<.008	<.005	20	1.20	180	<.10

*** Quality Standards for Class GA Groundwater, from 6 NYCRR Part 703.5

** Measured in μmhos/cm @ 25°C

* Monitors former cold dump

N/A Not available

Table E - 3 *(continued)*

1989 Water Quality Parameters for the High-Level Waste Tank Complex Groundwater Monitoring Unit (mg/L)

Location Code	Hydraulic Position	Sample Date	pH	Conductivity**	TOC	Phenols	TOX	Chloride	Nitrate-N	Sulfate	Fluoride
*** QUALITY STANDARDS ***			6.5-8.5	N/A	N/A	.001	N/A	250	10	250	1.5
WNW86-08	DOWN	06/06/89	6.82	531	5.3	<.005	<.010	11	.24	200	<.10
WNW86-08	DOWN	06/14/89	6.73	584	2.0	<.007	.011	14	.63	120	<.10
WNW86-08	DOWN	06/21/89	6.85	596	2.8	.061	<.010	13	.078	130	<.10
WNW86-08	DOWN	06/26/89	6.71	558	3.8	<.020	.015	11	.057	99	<.10
WNW86-08	DOWN	09/06/89	6.68	716	4.4	<.007	<.010	13	.11	120	<.10
WNW86-08	DOWN	10/26/89	6.51	674	8.2	<.008	.016	12	.180	160	<.10
WNW86-08	DOWN	12/12/89	6.64	591	7.8	<.008	.016	10	.053	130	.10
WNW86-08	DOWN	12/12/89	6.61	592	7.4	<.008	.037	11	<.050	130	.11
WNW86-09	DOWN	06/06/89	7.16	660	2.5	<.005	.015	52	1.20	130	<.10
WNW86-09	DOWN	06/14/89	6.96	653	1.0	<.020	.021	44	1.50	46	<.10
WNW86-09	DOWN	06/21/89	7.13	648	1.0	.053	<.010	46	1.30	47	<.10
WNW86-09	DOWN	06/26/89	6.99	648	1.0	<.008	.018	42	1.00	40	<.10
WNW86-09	DOWN	09/26/89	7.04	652	3.0	<.006	.014	35	.87	42	<.10
WNW86-09	DOWN	10/18/89	7.17	653	9.8	<.008	.013	30	.71	26	<.10
WNW86-09	DOWN	12/12/89	7.15	642	19.0	<.020	.022	24	1.80	26	<.10
WNW86-09	DOWN	12/12/89	7.14	636	1.9	.009	.017	38	1.60	30	<.10
WNW86-12	DOWN	06/09/89	7.44	649	< 1.0	<.007	.013	45	<.05	62	<.10
WNW86-12	DOWN	06/14/89	7.32	645	< 1.0	<.007	.010	43	.14	73	<.10
WNW86-12	DOWN	06/22/89	7.28	494	< 1.0	.007	<.010	44	<.05	66	<.10
WNW86-12	DOWN	06/28/89	7.38	651	< 1.0	<.007	<.010	45	<.05	59	<.10
WNW86-12	DOWN	09/20/89	7.45	666	9.0	<.007	<.010	51	<.05	64	<.10
WNW86-12	DOWN	10/18/89	7.30	673	4.3	<.008	<.010	50	<.05	62	<.10
WNW86-12	DOWN	11/20/89	7.50	679	< 1.0	<.008	N/A	50	.082	61	<.10
WNW86-12	DOWN	12/14/89	7.62	683	2.8	<.008	<.005	49	<.05	60	<.10

*** Quality Standards for Class GA Groundwater, from 6 NYCRR Part 703.5

** Measured in μmhos/cm@25°C

N/A Not available

Table E-4

1989 Total Metals for High-Level Waste Tank Complex Groundwater Monitoring Unit (mg/L)

Location Code	Hydraulic Position	Sample Date	Arsenic	Barium	Cadmium	Chromium	Iron	Lead	Manganese	Mercury	Selenium	Silver	Sodium
QUALITY STANDARD ***			.025	1.0	.01	.05	.30	.025	.30	.002	.01	.05	<20
WNW80-02	UP	05/24/89	<.005	.08	<.005	.020	2.4	<.005	.075	<.0004	<.005	<.005	5.0
WNW80-02	UP	06/12/89	<.005	< .06	<.005	.019	1.1	.005	.051	<.0004	<.005	<.005	5.0
WNW80-02	UP	06/19/89	.017	.08	.013	<.010	.37	<.005	.043	<.0004	<.005	<.005	8.0
WNW80-02	UP	06/26/89	<.005	.08	.006	<.010	2.2	.008	.095	<.0004	<.005	<.005	8.0
WNW80-02	UP	09/07/89	<.005	.06	<.005	<.010	2.8	<.005	.056	<.0002	<.005	<.005	2.8
WNW80-02	UP	10/23/89	<.005	.07	.010	<.010	12.0	.014	.14	<.0004	<.005	<.005	< 5.0
WNW80-02	UP	12/14/89	<.005	.11	<.005	<.010	5.8	.013	.098	<.0004	<.005	<.010	3.5
WNW80-02	UP	12/14/89	<.005	.07	<.005	<.010	.62	<.005	.019	<.0004	<.005	<.010	3.5
WNDMPNE*	DOWN	06/09/89	<.005	< .06	<.005	.030	11.0	.011	.63	<.0004	<.005	.005	15.0
WNDMPNE	DOWN	06/14/89	.013	.11	<.005	.036	16.0	.011	.64	<.0004	<.005	<.005	15.0
WNDMPNE	DOWN	06/22/89	.014	.16	<.005	<.010	1.9	<.005	.16	<.0004	<.005	.005	12.0
WNDMPNE	DOWN	06/28/89	.022	.10	.011	<.010	.91	<.005	.11	<.0004	<.005	.007	19.0
WNDMPNE	DOWN	09/26/89	<.005	< .06	.008	<.010	.74	<.005	.031	<.0004	<.005	.005	24.0
WNDMPNE	DOWN	11/13/89	<.005	.14	.010	<.010	.05	<.005	.012	<.0004	<.005	<.005	21.0
WNDMPNE	DOWN	12/19/89	<.005	.11	<.005	<.010	6.5	.260	.17	<.0004	<.005	<.010	18.0
WNDMPNE	DOWN	12/19/89	<.005	.07	<.005	<.010	.21	<.005	.014	<.0004	<.005	<.010	19.0
WNW86-07	DOWN	06/06/89	<.005	< .06	<.005	.022	1.8	<.005	.57	<.0004	<.005	.006	14.0
WNW86-07	DOWN	06/14/89	<.005	< .06	<.005	.025	.39	<.005	.26	<.0004	<.005	<.005	12.0
WNW86-07	DOWN	06/21/89	.022	< .06	.010	<.010	1.6	.005	.39	<.0004	<.005	.006	11.0
WNW86-07	DOWN	06/26/89	.017	< .06	<.005	<.010	1.0	<.005	.24	<.0004	<.005	<.005	10.0
WNW86-07	DOWN	09/07/89	<.005	< .06	.007	<.010	1.2	<.005	.36	<.0002	<.005	.005	7.0
WNW86-07	DOWN	10/26/89	<.005	.05	.008	<.010	1.0	.006	.28	<.0004	.021	.008	16.0
WNW86-07	DOWN	12/12/89	<.005	< .06	.007	<.010	.55	<.005	.68	<.0004	<.005	<.010	12.0
WNW86-07	DOWN	12/12/89	<.005	< .06	<.005	<.010	.26	<.005	.94	<.0004	<.005	<.010	9.9

*** Quality Standards for Class GA Groundwater, from 6 NYCRR Part 703.5

* Monitors former cold dump

Table E-4 *(continued)*

1989 Total Metals for High-Level Waste Tank Complex Groundwater Monitoring Unit (mg/L)

Location Code	Hydraulic Position	Sample Date	Arsenic	Barium	Cadmium	Chromium	Iron	Lead	Manganese	Mercury	Selenium	Silver	Sodium
QUALITY STANDARD ***			.025	1.0	.01	.05	.30	.025	.30	.002	.01	.05	<20
WNW86-08	DOWN	06/06/89	.006	.06	<.005	.030	8.2	.006	8.0	<.0004	<.005	<.005	9.0
WNW86-08	DOWN	06/14/89	.021	.14	<.005	.040	24.0	.016	4.5	<.0004	<.005	<.005	8.0
WNW86-08	DOWN	06/21/89	.007	.11	.008	.011	7.0	.008	4.1	<.0004	<.005	<.005	10.0
WNW86-08	DOWN	06/26/89	<.005	.12	<.005	<.010	4.7	.006	6.5	<.0004	<.005	<.005	10.0
WNW86-08	DOWN	09/06/89	<.005	.07	.008	<.020	2.7	<.005	6.3	<.0002	<.005	<.005	8.0
WNW86-08	DOWN	10/26/89	.006	.13	.007	<.010	7.7	.006	13.0	<.0004	.018	<.005	6.0
WNW86-08	DOWN	12/12/89	.006	.15	.007	<.010	5.7	.006	11.0	<.0004	<.005	<.010	6.1
WNW86-08	DOWN	12/12/89	<.005	.11	<.005	<.010	5.9	<.005	11.0	<.0004	<.005	<.010	5.7
WNW86-09	DOWN	06/06/89	.016	.12	<.005	.038	24.0	.022	.62	<.0004	<.005	.007	11.0
WNW86-09	DOWN	06/14/89	.007	.40	<.005	.038	11.0	.016	.37	<.0004	<.005	.006	10.0
WNW86-09	DOWN	06/21/89	.017	.69	.008	.056	74.0	.068	2.8	<.0004	<.005	.009	13.0
WNW86-09	DOWN	06/26/89	.009	.48	.010	.034	43.0	.042	1.6	<.0004	<.005	<.005	11.0
WNW86-09	DOWN	09/26/89	<.005	< .06	.010	<.010	9.6	.007	.44	<.0002	<.005	.009	10.0
WNW86-09	DOWN	10/18/89	<.005	.13	.014	.013	16.0	.010	.66	<.0004	<.005	.008	11.0
WNW86-09	DOWN	12/12/89	.006	.24	.008	.010	13.0	.008	.62	<.0004	<.005	<.010	7.3
WNW86-09	DOWN	12/12/89	<.005	.21	<.005	<.010	4.4	<.005	.16	<.0004	<.005	<.010	8.3
WNW86-12	DOWN	06/09/89	<.005	.16	<.005	.020	2.3	<.005	.10	<.0004	<.005	<.005	12.0
WNW86-12	DOWN	06/14/89	<.005	.26	<.005	.025	2.4	<.005	.11	<.0004	<.005	.008	11.0
WNW86-12	DOWN	06/22/89	<.005	.40	.008	<.010	1.6	<.005	.11	<.0004	<.005	.005	11.0
WNW86-12	DOWN	06/28/89	.013	.39	.010	<.010	1.4	<.005	.11	<.0004	<.005	<.005	11.0
WNW86-12	DOWN	09/20/89	<.005	.30	<.005	<.010	1.0	<.005	.10	<.0002	<.005	.007	10.0
WNW86-12	DOWN	10/18/89	<.005	.16	.011	<.010	.99	<.005	.10	<.0004	<.005	.005	10.0
WNW86-12	DOWN	11/20/89	<.005	.37	.009	<.010	.58	<.005	.10	<.0004	<.005	<.005	14.0
WNW86-12	DOWN	12/14/89	<.005	.34	<.006	.012	1.3	<.006	.086	<.0004	<.005	<.010	10.0

*** Quality Standards for Class GA Groundwater, from 6 NYCRR Part 703.5

* Monitors former cold dump

Table E-5

1989 Dissolved Metals for High-Level Waste Tank Complex Groundwater Monitoring Unit (mg/L)

Location Code	Hydraulic Position	Sample Date	Arsenic	Barium	Cadmium	Chromium	Iron	Lead	Manganese	Mercury	Selenium	Silver	Sodium
QUALITY STANDARD ***			.025	1.0	.01	.05	.30	.025	.30	.002	.01	.05	<20
WNW80-02	UP	05/24/89	< .005	< .06	< .005	< .010	< .05	< .005	.024	< .0004	< .005	< .005	< 5.0
WNW80-02	UP	06/12/89	< .005	< .06	< .005	< .010	< .05	< .005	.012	< .0004	< .005	< .005	5.0
WNW80-02	UP	06/19/89	< .005	< .06	.007	< .010	< .03	< .005	< .010	< .0004	< .005	.007	6.0
WNW80-02	UP	06/26/89	< .005	< .06	< .005	< .010	< .03	< .005	.015	< .0004	< .005	< .005	7.0
WNW80-02	UP	09/07/89	< .005	< .06	< .005	< .005	< .03	< .005	.016	< .0002	< .005	< .005	3.5
WNW80-02	UP	10/23/89	< .005	.07	< .005	< .010	< .03	< .005	.027	< .0004	< .005	< .005	< 5.0
WNW80-02	UP	12/14/89	< .005	.06	< .005	< .010	< .05	< .005	.016	< .0004	< .005	< .010	3.1
WNW80-02	UP	12/14/89	< .005	.07	< .005	< .010	< .05	< .005	.010	< .0004	< .005	< .010	3.0
WNDMPNE*	DOWN	06/09/89	< .005	< .06	< .005	< .010	< .05	< .005	.20	< .0004	< .005	< .005	15.0
WNDMPNE	DOWN	06/14/89	< .005	< .06	< .005	.012	.06	< .005	.11	< .0004	< .005	< .005	14.0
WNDMPNE	DOWN	06/22/89	< .005	.08	< .005	< .010	< .03	< .005	.049	< .0004	< .005	< .005	12.0
WNDMPNE	DOWN	06/28/89	< .005	< .06	< .005	< .010	.20	< .005	.33	< .0004	< .005	< .005	18.0
WNDMPNE	DOWN	09/26/89	< .005	< .06	< .005	< .010	.04	< .005	.024	< .0004	< .005	< .005	22.0
WNDMPNE	DOWN	11/13/89	< .005	< .06	< .005	< .010	< .05	< .005	< .010	< .0004	< .005	< .005	19.0
WNDMPNE	DOWN	12/19/89	< .005	.08	< .005	< .010	< .05	.020	.022	< .0004	< .005	< .010	16.0
WNDMPNE	DOWN	12/19/89	< .005	.07	< .005	< .010	< .05	< .005	.009	< .0004	< .005	< .010	8.8
WNW86-07	DOWN	06/06/89	< .005	< .06	< .005	< .010	< .05	< .005	.20	< .0004	< .005	< .005	13.0
WNW86-07	DOWN	06/14/89	< .005	< .06	< .005	< .010	< .05	< .005	.18	< .0004	< .005	< .005	10.0
WNW86-07	DOWN	06/21/89	< .005	< .06	< .005	< .010	< .03	< .005	.089	< .0004	< .005	< .005	12.0
WNW86-07	DOWN	06/26/89	< .005	< .06	< .005	< .010	< .03	< .005	.089	< .0004	< .005	< .005	11.0
WNW86-07	DOWN	09/07/89	< .005	< .06	< .005	< .005	.03	< .005	.013	< .0002	< .005	< .005	6.0
WNW86-07	DOWN	10/26/89	< .005	< .05	.007	< .010	.04	< .005	.10	< .0004	< .005	< .005	7.0
WNW86-07	DOWN	12/12/89	< .005	< .06	< .005	< .010	< .05	< .005	.57	< .0004	< .005	< .010	9.4
WNW86-07	DOWN	12/12/89	< .005	< .06	< .005	< .010	< .05	< .005	.88	< .0004	< .005	< .010	9.3

*** Quality Standards for Class GA Groundwater, from 6 NYCRR Part 703.5

* Monitors former cold dump

Table E-5 *(continued)*

1989 Dissolved Metals for High-Level Waste Tank Complex Groundwater Monitoring Unit (mg/L)

Location Code	Hydraulic Position	Sample Date	Arsenic	Barium	Cadmium	Chromium	Iron	Lead	Manganese	Mercury	Selenium	Silver	Sodium
QUALITY STANDARD ***			.025	1.0	.01	.05	.30	.025	.30	.002	.01	.05	<20
WNW86-08	DOWN	06/06/89	<.005	< .06	<.005	< .010	.50	<.005	8.1	<.0004	<.005	<.005	8.0
WNW86-08	DOWN	06/14/89	<.005	< .06	<.005	< .010	.31	<.005	7.1	<.0004	<.005	<.005	8.0
WNW86-08	DOWN	06/21/89	<.005	< .06	.008	< .010	.11	<.005	4.8	<.0004	<.005	<.005	10.0
WNW86-08	DOWN	06/26/89	<.005	< .06	<.005	< .010	.16	<.005	6.5	<.0004	<.005	<.005	9.0
WNW86-08	DOWN	09/06/89	<.005	.07	<.005	< .005	.05	<.005	5.2	<.0002	<.005	<.005	6.0
WNW86-08	DOWN	10/26/89	<.005	.10	<.005	< .010	1.1	<.005	10.0	<.0004	<.005	<.005	< 5.0
WNW86-08	DOWN	12/12/89	<.005	.13	<.005	< .010	1.3	<.005	9.8	<.0004	<.005	<.010	5.9
WNW86-08	DOWN	12/12/89	<.005	.10	<.006	< .010	1.1	<.005	11.0	<.0004	<.005	<.010	5.6
WNW86-09	DOWN	06/06/89	<.005	< .06	<.005	.010	< .05	<.005	.010	<.0004	<.005	<.005	9.0
WNW86-09	DOWN	06/14/89	<.005	< .06	<.005	< .010	< .05	<.005	.008	<.0004	<.005	<.005	9.0
WNW86-09	DOWN	06/21/89	<.005	< .06	<.005	< .010	< .03	<.005	.011	<.0004	<.005	<.005	10.0
WNW86-09	DOWN	06/26/89	<.005	< .06	<.005	< .010	< .03	<.005	.010	<.0004	<.005	<.005	10.0
WNW86-09	DOWN	09/26/89	<.005	< .06	<.005	< .010	.03	<.005	.016	<.0002	<.005	<.005	6.0
WNW86-09	DOWN	10/18/89	<.005	< .06	.007	< .010	< .04	<.005	.018	<.0004	<.005	<.005	7.1
WNW86-09	DOWN	12/12/89	<.005	.17	.006	< .010	< .05	<.005	.009	<.0004	<.005	<.010	7.0
WNW86-09	DOWN	12/12/89	<.005	.17	<.005	< .010	< .05	<.005	.012	<.0004	<.005	<.010	7.3
WNW86-12	DOWN	06/09/89	<.005	< .06	<.005	< .010	.33	<.005	.093	<.0004	<.005	<.005	10.0
WNW86-12	DOWN	06/14/89	<.005	< .06	<.005	< .010	.37	<.005	.093	<.0004	<.005	<.005	11.0
WNW86-12	DOWN	06/22/89	<.005	< .06	<.005	< .010	.30	<.005	.077	<.0004	<.005	.009	11.0
WNW86-12	DOWN	06/28/89	<.005	< .06	<.005	< .010	.30	<.005	.079	<.0004	<.005	<.005	13.0
WNW86-12	DOWN	09/20/89	<.005	.26	<.005	< .005	.35	<.005	.085	<.0002	<.005	<.005	9.0
WNW86-12	DOWN	10/18/89	<.005	.12	<.005	< .010	.35	<.005	.093	<.0004	<.005	<.005	10.0
WNW86-12	DOWN	11/20/89	<.005	< .06	<.005	< .010	.30	<.005	.095	<.0004	<.005	<.005	13.0
WNW86-12	DOWN	12/14/89	<.005	.31	<.005	< .010	.32	<.005	.086	<.0004	<.005	<.010	10.0

*** Quality Standards for Class GA Groundwater, from 6 NYCRR Part 703.5

* Monitors former cold dump

Table E-6

1989 Radioactivity Concentrations for Groundwater in High-Level Radioactive Waste Tank Complex Monitoring Unit (μCi /mL)

Location Code	Hydraulic Position	Sample Date	Gross Alpha	Gross Beta	H-3	Cs-137	Co-60
DOE DCGs			3.0E-08	1.0E-06	2.0E-03	3E-06	5E-06
Quality Standard***			1.5E-08	1.0E-06	2.0E-05	N/A	N/A
WNW80-02	UP	05/24/89	<1.29E-09	1.23E-09 ± 1.19E−09	<1E-7	<1.1E-08	<1.4E-08
WNW80-02	UP	06/12/89	<1.31E-09	1.59E-09 ± 1.24E−09	2.37E-7 ± 1.21E−7	<3.7E-08	<3.8E-08
WNW80-02	UP	06/19/89	<3.40E-10	<1.09E-09	<1E-7	<3.7E-08	<3.8E-08
WNW80-02	UP	06/26/89	<9.00E-10	<1.16E-09	<1E-7	<3.7E-08	<3.8E-08
WNW80-02	UP	09/07/89	<1.34E-09	1.68E-09 ± 1.26E−09	1.95E-7 ± 1.15E−7	<3.7E-08	<3.8E-08
WNW80-02	UP	10/23/89	1.85E-09 ± 1.80E−09	1.80E-09 ± 1.24E−09	1.37E-7 ± 1.08E−7	<3.7E-08	<3.8E-08
WNW80-02	UP	12/14/89	<1.10E-09	1.38E-09 ± 1.19E−09	1.30E-7 ± 1.10E−7	<3.7E-08	<3.8E-08
WNW80-02	UP	12/14/89	<1.13E-09	1.21E-09 ± 1.17E−09	1.23E-7 ± 1.11E−7	<3.7E-08	<3.8E-08
WNDMPNE*	DOWN	06/09/89	<2.91E-09	1.30E-07 ± 7.05E−09	8.60E-7 ± 1.36E−7	<1.1E-08	<1.4E-08
WNDMPNE	DOWN	06/14/89	<2.64E-09	1.13E-07 ± 6.49E−09	4.92E-7 ± 1.28E−7	<3.7E-08	<3.8E-08
WNDMPNE	DOWN	06/22/89	<1.59E-09	8.59E-08 ± 5.60E−09	3.17E-7 ± 1.24E−7	<3.7E-08	<3.8E-08
WNDMPNE	DOWN	06/28/89	<1.68E-09	1.08E-07 ± 6.44E−09	5.86E-7 ± 1.29E−7	<3.7E-08	<3.8E-08
WNDMPNE	DOWN	09/26/89	<1.81E-09	9.93E-08 ± 6.21E−09	8.44E-7 ± 1.29E−7	<3.7E-08	<3.8E-08
WNDMPNE	DOWN	11/13/89	<3.34E-09	1.32E-07 ± 7.11E−09	5.86E-7 ± 1.37E−7	<3.7E-08	<3.8E-08
WNDMPNE	DOWN	12/19/89	<5.22E-10	1.24E-07 ± 6.79E−09	9.24E-7 ± 1.21E−7	<3.7E-08	<3.8E-08
WNDMPNE	DOWN	12/19/89	<1.81E-09	1.20E-07 ± 6.65E−09	8.85E-7 ± 1.19E−7	<3.7E-08	<3.8E-08
WNW86-07	DOWN	06/06/89	<6.87E-10	6.55E-09 ± 1.92E−09	<1E-7	<1.1E-08	<1.4E-08
WNW86-07	DOWN	06/14/89	<1.34E-09	4.38E-09 ± 1.64E−09	<1E-7	<3.7E-08	<3.8E-08
WNW86-07	DOWN	06/21/89	<2.27E-09	3.12E-09 ± 1.47E−09	<1E-7	<3.7E-08	<3.8E-08
WNW86-07	DOWN	06/26/89	<3.57E-09	5.63E-09 ± 1.86E−09	<1.17E-7	<3.7E-08	<3.8E-08
WNW86-07	DOWN	09/07/89	<7.49E-09	4.66E-09 ± 1.86E−09	4.24E-7 ± 1.19E−7	<3.7E-08	<3.8E-08
WNW86-07	DOWN	10/26/89	<2.38E-09	5.34E-09 ± 1.79E−09	<1.05E-7	<3.7E-08	<3.8E-08
WNW86-07	DOWN	12/12/89	<3.14E-09	7.31E-09 ± 2.04E−09	2.44E-7 ± 1.07E−7	<3.7E-08	<3.8E-08
WNW86-07	DOWN	12/12/89	<1.99E-09	4.16E-09 ± 1.63E−09	1.73E-7 ± 1.07E−7	<3.7E-08	<3.8E-08

*** Quality Standards for Class GA Groundwaters from 6 NYCRR Part 703.5

* Monitors former cold dump

N/A Not available

1989 Radioactivity Concentrations for Groundwater in High-Level Radioactive Waste Tank Complex Monitoring Unit (μ Ci/mL)

Location Code	Hydraulic Position	Sample Date	Gross Alpha	Gross Beta	H-3	Cs-137	Co-60
DOE DCGs			3.0E-08	1.0E-06	2.0E-03	3E-06	5E-06
Quality Standard***			1.5E-08	1.0E-06	2.0E-05	N/A	N/A
WNW86-08	DOWN	06/06/89	<4.51E-10	1.25E-08 ±2.34E−09	<1E-07	<1.1E-08	<1.4E-08
WNW86-08	DOWN	06/14/89	<2.45E-09	1.10E-08 ±2.24E−09	5.92E-07 ± 1.53E-07	<3.7E-08	<3.8E-08
WNW86-08	DOWN	06/21/89	<2.17E-09	9.88E-09 ±2.19E−09	1.92E-06 ± 1.58E-07	<3.7E-08	<3.8E-08
WNW86-08	DOWN	06/26/89	<1.69E-09	1.04E-08 ±2.15E−09	7.18E-07 ± 1.35E-07	<3.7E-08	<3.8E-08
WNW86-08	DOWN	09/06/89	<4.77E-09	1.13E-08 ±2.42E−09	2.43E-06 ± 1.78E-07	<3.7E-08	<3.8E-08
WNW86-08	DOWN	10/26/89	<3.37E-09	1.10E-08 ±2.34E−09	<1E-07	<3.7E-08	<3.8E-08
WNW86-08	DOWN	12/12/89	<2.30E-09	1.13E-08 ±2.28E−09	<1E-07	<3.7E-08	<3.8E-08
WNW86-08	DOWN	12/12/89	<1.58E-09	8.22E-0 9±1.99E−09	<1E-07	<3.7E-08	<3.8E-08
WNW86-09	DOWN	06/06/89	<1.74E-09	1.92E-07 ± 8.54E−09	2.18E-06 ± 1.72E-07	<1.1E-08	<1.4E-08
WNW86-09	DOWN	06/14/89	<2.37E-09	1.84E-07 ±8.38E−09	2.44E-06 ± 1.73E-07	<3.7E-08	<3.8E-08
WNW86-09	DOWN	06/21/89	<4.21E-09	1.82E-07 ±8.42E−09	2.29E-06 ± 1.67E-07	<3.7E-08	<3.8E-08
WNW86-09	DOWN	06/26/89	<3.63E-09	1.75E-07 ±8.24E−09	2.31E-06 ± 1.69E-07	<3.7E-08	<3.8E-08
WNW86-09	DOWN	09/26/89	<3.22E-09	2.33E-07 ±9.48E−09	2.66E-06 ± 1.74E-07	<3.7E-08	<3.8E-08
WNW86-09	DOWN	10/18/89	<1.90E-09	2.06E-07 ±8.90E−09	2.74E-06 ± 1.69E-07	<3.7E-08	<3.8E-08
WNW86-09	DOWN	12/12/89	<3.47E-09	2.42E-07 ±9.63E−09	2.42E-06 ± 1.61E-07	<3.7E-08	<3.8E-08
WNW86-09	DOWN	12/12/89	<3.45E-09	2.21E-07 ±9.46E−09	2.37E-06 ± 1.61E-07	<3.7E-08	<3.8E-08
WNW86-12*	DOWN	06/09/89	<2.56E-09	1.76E-09 ± 1.38E−09	4.60E-06 ± 2.30E-07	<1.1E-08	<1.4E-08
WNW86-12	DOWN	06/14/89	4.65E-09 ± 4.52E−09	2.47E-09 ±1.48E-09	3.57E-06 ± 2.04E-07	<3.7E-08	<3.8E-08
WNW86-12	DOWN	06/22/89	<1.83E-09	2.05E-09 ±1.41E−09	3.50E-06 ± 2.00E-07	<3.7E-08	<3.8E-08
WNW86-12	DOWN	06/28/89	<3.60E-09	1.40E-09 ±1.35E−09	3.42E-06 ± 1.98E-07	<3.7E-08	<3.8E-08
WNW86-12	DOWN	09/20/89	<2.31E-09	3.85E-09 ±1.68E−09	3.31E-06 ± 1.89E-07	<3.7E-08	<3.8E-08
WNW86-12	DOWN	10/18/89	5.04E-09 ± 4.40E−09	<1.25E-09	3.41E-06 ± 1.87E-07	<3.7E-08	<3.8E-08
WNW86-12	DOWN	11/20/89	<1.87E-09	1.85E-09 ±1.39E−09	3.61E-06 ± 1.91E-07	<3.7E-08	<3.8E-08
WNW86-12	DOWN	12/14/89	<3.36E-09	<1.29E-09	3.56E-06 ± 1.89E−07	<3.7E-08	<3.8E-08

*** Quality Standards for Class GA Groundwaters from 6NYCRR Part 703.5

* Monitors former cold dump

N/A Not available

Table E-7

1989 Water Quality Parameters for Low-Level Radioactive Waste Lagoon System Groundwater Monitoring Unit (mg/L)

Location Code	Hydraulic Position	Sample Date	pH	Conductivity *	TOC	Phenols	TOX	Chloride	Nitrate-N	Sulfate	Fluoride
QUALITY STANDARDS ***			6.5-8.5	N/A	N/A	.001	N/A	250	10	250	1.5
WNW86-06	UP	06/05/89	6.72	3106	1.9	.014	.016	860	.14	37	<.10
WNW86-06	UP	06/13/89	6.64	3516	1.3	<.007	.024	1000	.12	36	<.10
WNW86-06	UP	06/21/89	6.53	3593	2.0	.014	.016	1100	<.05	75	<.10
WNW86-06	UP	06/28/89	6.71	3270	1.8	.076	.024	980	.12	42	<.10
WNW86-06	UP	09/26/89	6.54	917	< 1.0	<.020	.010	210	.027	18	<.10
WNW86-06	UP	10/26/89	6.55	1301	4.1	<.008	.018	340	<.06	18	<.10
WNW86-06	UP	12/13/89	6.65	2430	1.4	.018	<.005	670	.13	49	<.10
WNW86-06	UP	12/13/89	6.64	2485	2.8	<.008	.025	610	.16	47	<.10
WNGSEEP	DOWN	06/08/89	6.32	535	1.0	<.020	.016	69	.61	56	<.10
WNGSEEP	DOWN	06/19/89	6.17	550	4.0	<.007	<.010	88	.63	52	<.10
WNGSEEP	DOWN	06/22/89	6.09	551	< 1.0	<.007	<.010	65	.57	53	<.10
WNGSEEP	DOWN	06/28/89	6.04	555	1.2	<.008	<.010	60	.62	80	<.10
WNGSEEP	DOWN	10/04/89	6.16	709	2.9	<.007	<.010	90	.35	60	<.10
WNGSEEP	DOWN	10/23/89	6.24	679	1.0	<.008	<.010	87	.40	51	<.10
WNGSEEP	DOWN	12/11/89	6.32	593	3.2	<.008	<.005	61	.82	54	<.10
WNGSEEP	DOWN	12/11/89	6.34	593	1.2	<.008	.006	57	.76	56	<.10
WNSP008	DOWN	06/08/89	6.84	961	2.0	<.007	.017	100	.75	64	<.10
WNSP008	DOWN	06/13/89	6.77	869	1.5	<.007	.013	89	.56	92	<.10
WNSP008	DOWN	06/22/89	6.61	875	2.0	<.007	<.010	70	.68	55	<.10
WNSP008	DOWN	06/28/89	6.67	967	3.1	<.008	<.010	98	1.50	79	<.10
WNSP008	DOWN	10/04/89	6.90	963	3.0	<.006	<.010	100	.50	55	<.10
WNSP008	DOWN	10/23/89	6.90	881	2.8	<.020	.012	83	.56	50	.12
WNSP008	DOWN	12/11/89	6.76	927	1.9	<.008	.014	81	.64	80	<.10
WNSP008	DOWN	12/11/89	6.91	933	2.8	<.008	.103	80	.54	85	<.10
WNW80-05	DOWN	05/24/89	6.77	658	< 1.0	<.005	<.010	76	.66	61	<.10
WNW80-05	DOWN	06/12/89	6.72	762	< 1.0	<.020	.013	78	.43	91	<.10
WNW80-05	DOWN	06/19/89	6.76	722	< 1.0	<.007	<.010	73	.58	70	<.10
WNW80-05	DOWN	06/26/89	6.77	608	1.8	<.007	<.010	59	.34	71	<.10
WNW80-05	DOWN	10/03/89	6.61	1065	4.0	<.007	<.010	160	.32	75	<.10
WNW80-05	DOWN	11/13/89	6.54	1019	< 1.0	<.008	N/A	150	.30	68	<.10
WNW80-05	DOWN	12/18/89	6.96	890	< 1.0	<.007	.030	100	.39	60	<.10
WNW80-05	DOWN	12/18/89	6.92	851	1.2	<.008	.020	97	.42	55	<.10

*** Quality Standards for Class GA Groundwaters, from 6 NYCRR Part 703.5

* Measured in μmhos/cm @ 25°C N/A Not available

1989 Water Quality Parameters for Low-level Radioactive Waste Lagoon System Groundwater Monitoring Unit (mg/L)

Location Code	Hydraulic Position	Sample Date	pH	Conductivity*	TOC	Phenols	TOX	Chloride	Nitrate-N	Sulfate	Fluoride
QUALITY STANDARDS ***			6.5-8.5	N/A	N/A	.001	N/A	250	10	250	1.5
WNW80-06	DOWN	05/24/89	6.32	706	3.0	<.005	<.010	44	.096	83	<.10
WNW80-06	DOWN	06/12/89	6.24	660	1.0	<.007	<.010	39	<.05	110	<.10
WNW80-06	DOWN	06/19/89	6.18	731	< 1.0	<.008	<.010	38	.42	100	<.10
WNW80-06	DOWN	06/26/89	6.10	793	3.8	<.007	<.010	37	.36	130	<.10
WNW80-06	DOWN	10/23/89	6.27	873	9.6	<.020	<.010	35	.051	140	.12
WNW80-06	DOWN	11/13/89	6.41	791	4.0	<.020	N/A	32	.056	160	<.10
WNW80-06	DOWN	12/18/89	6.33	857	3.0	<.008	<.010	28	.14	170	.11
WNW80-06	DOWN	12/18/89	6.48	813	3.0	<.008	.010	42	.074	120	<.10
WNW86-03	DOWN	06/05/89	7.27	861	2.3	<.005	<.010	120	1.50	41	<.10
WNW86-03	DOWN	06/12/89	7.26	859	< 1.0	<.007	<.010	120	1.20	40	<.10
WNW86-03	DOWN	06/20/89	7.15	858	< 1.0	<.007	<.010	120	1.30	38	<.10
WNW86-03	DOWN	06/28/89	7.20	863	< 1.0	.065	<.010	120	1.10	36	<.10
WNW86-03	DOWN	09/27/89	7.22	880	< 1.0	<.020	<.010	130	.91	38	<.10
WNW86-03	DOWN	10/18/89	7.21	889	17.0	<.008	<.010	130	1.50	37	<.10
WNW86-03	DOWN	12/11/89	7.36	929	2.0	<.008	.006	180	1.60	37	<.10
WNW86-03	DOWN	12/11/89	7.29	925	8.0	<.020	.001	150	1.60	43	<.10
WNW86-04	DOWN	06/05/89	7.21	845	< 1.0	<.005	<.010	110	1.50	59	<.10
WNW86-04	DOWN	06/12/89	7.23	851	< 1.0	<.020	<.010	110	1.20	40	<.10
WNW86-04	DOWN	06/20/89	7.01	858	< 1.0	<.007	<.010	110	1.40	39	<.10
WNW86-04	DOWN	06/28/89	7.08	857	< 1.0	<.020	<.010	110	1.20	40	<.10
WNW86-04	DOWN	09/27/89	7.25	884	1.2	<.006	<.010	120	1.60	38	<.10
WNW86-04	DOWN	10/18/89	7.13	895	7.0	<.008	<.010	130	1.20	38	<.10
WNW86-04	DOWN	12/11/89	7.25	933	< 1.0	<.008	.025	130	1.50	120	<.10
WNW86-04	DOWN	12/11/89	7.25	919	1.3	<.020	<.005	130	1.30	53	<.10
WNW86-05	DOWN	06/12/89	6.66	879	< 1.0	<.010	.040	42	<.10	63.82	.14
WNW86-05	DOWN	06/16/89	6.51	758	22.4	<.010	.050	15	<.10	72.30	.13
WNW86-05	DOWN	06/22/89	6.74	577	19.6	<.010	<.010	.8	<.10	44.80	.14
WNW86-05	DOWN	06/26/89	6.54	754	24.0	<.010	<.010	13	<.10	40.70	.10
WNW86-05	DOWN	10/03/89	6.53	966	16.4	.027	.019	65	<10	60.40	.11
WNW86-05	DOWN	12/13/89	6.73	940	13.8	.014	.023	29	<.10	225	.12
WNW86-05	DOWN	12/14/89	6.75	969	13.6	<.010	<.010	28	<.10	230	.11
WNW86-05	DOWN	12/18/89	6.65	1054	14.7	.010	.025	33	<.10	88	.10

*** Quality Standards for Class GA Groundwaters, from 6 NYCRR Part 703.5

* Measured in μmhos/cm @ 25°C

N/A Not available

Table E-8

1989 Total Metals for Low-Level Radioactive Waste Lagoon System Groundwater Monitoring Unit (mg/L)

Location Code	Hydraulic Position	Sample Date	Arsenic	Barium	Cadmium	Chromium	Iron	Lead	Manganese	Mercury	Selenium	Silver	Sodium
QUALITY STANDARD ***			.025	1.0	.01	.05	.30	.025	.30	.002	.01	.05	<20
WNW86-06	UP	06/05/89	<.005	< .06	<.006	.027	.61	<.007	3.3	<.0004	<.005	.008	470
WNW86-06	UP	06/13/89	<.005	< .06	.006	.027	.41	<.005	2.4	<.0004	<.005	.005	500
WNW86-06	UP	06/21/89	.020	.13	.007	.019	.57	.006	2.2	<.0004	<.005	.010	680
WNW86-06	UP	06/28/89	.009	.13	.006	<.010	.35	<.005	3.1	<.0004	<.005	<.005	570
WNW86-06	UP	09/26/89	<.005	< .05	.014	<.010	.32	<.005	1.4	<.0004	<.005	<.005	120
WNW86-06	UP	10/26/89	<.005	.07	.009	<.010	.15	<.005	2.4	<.0004	.021	.005	160
WNW86-06	UP	12/13/89	<.005	.12	<.005	<.010	.34	<.005	4.8	<.0004	<.005	<.010	350
WNW86-06	UP	12/13/89	<.005	.12	<.005	<.010	.81	<.005	4.8	<.0004	<.005	<.010	350
WNGSEEP	DOWN	06/08/89	<.005	< .06	<.005	.020	.06	<.005	<.005	<.0004	<.005	<.005	14.0
WNGSEEP	DOWN	06/19/89	.015	.13	.013	<.010	.06	<.005	.019	<.0004	<.005	<.005	15.0
WNGSEEP	DOWN	06/22/89	<.005	.12	.008	<.020	.05	<.005	.011	<.0004	<.005	<.005	14.0
WNGSEEP	DOWN	06/28/89	.008	.14	<.005	<.010	.11	<.005	<.010	<.0004	<.005	<.005	14.0
WNGSEEP	DOWN	10/04/89	<.005	.14	.007	<.010	.04	<.005	<.010	<.0004	.005	.005	17.0
WNGSEEP	DOWN	10/23/89	<.005	.15	.010	<.010	.03	<.005	<.010	<.0004	.014	.008	14.0
WNGSEEP	DOWN	12/11/89	<.005	.13	<.005	<.010	<.05	.006	<.005	<.0004	<.005	<.010	14.0
WNGSEEP	DOWN	12/11/89	<.005	.13	.010	<.010	<.05	.006	<.005	<.0004	<.005	<.010	14.0
WNSP008	DOWN	06/08/89	<.005	< .06	<.005	.023	.05	<.005	2.3	<.0004	<.005	<.005	47.0
WNSP008	DOWN	06/13/89	<.005	< .06	<.005	.025	.06	<.005	2.0	<.0004	<.005	<.005	45.0
WNSP008	DOWN	06/22/89	.015	.06	<.005	<.010	.03	<.005	1.8	<.0004	<.005	<.005	42.0
WNSP008	DOWN	06/28/89	.033	.07	.006	.010	.05	<.005	2.1	<.0004	<.005	<.005	49.0
WNSP008	DOWN	10/04/89	<.005	.08	.006	<.010	.11	<.005	2.3	<.0004	.006	.007	56.0
WNSP008	DOWN	10/23/89	<.005	.08	.009	<.010	.07	<.005	2.1	<.0004	<.005	.007	47.0
WNSP008	DOWN	12/11/89	<.005	.09	.012	.011	.05	.010	2.0	<.0004	<.005	<.010	55.0
WNSP008	DOWN	12/11/89	<.005	.09	.014	<.020	.06	.017	1.9	<.0004	<.005	<.010	56.0
WNW80-05	DOWN	05/24/89	.005	.09	<.005	.029	26.0	.018	.50	<.0004	<.005	<.005	18.0
WNW80-05	DOWN	06/12/89	<.005	< .06	<.005	.026	4.2	<.006	.074	<.0004	<.005	.011	22.0
WNW80-05	DOWN	06/19/89	.022	.08	.015	.012	14.0	.014	.13	<.0004	<.005	.016	24.0
WNW80-05	DOWN	06/26/89	.010	.11	.008	<.010	6.9	.010	.12	<.0004	<.005	<.005	20.0
WNW80-05	DOWN	10/03/89	<.005	.15	.010	.020	3.9	.008	.062	.0023	<.005	.007	29.0
WNW80-05	DOWN	11/13/89	<.005	.21	.008	<.010	1.3	<.005	.038	<.0004	<.005	<.005	31.0
WNW80-05	DOWN	12/18/89	<.005	.13	<.005	<.010	7.6	.007	.034	<.0004	<.005	<.010	26.0
WNW80-05	DOWN	12/18/89	<.005	.12	<.005	<.010	2.1	<.005	.014	<.0004	<.005	<.010	26.0

*** Quality Standards for Class GA Groundwater, from 6 NYCRR Part 703.5

Table E-8 *(continued)*

1989 Total Metals for Low-Level Radioactive Waste Lagoon System Groundwater Monitoring Unit (mg/L)

Location Code	Hydraulic Position	Sample Date	Arsenic	Barium	Cadmium	Chromium	Iron	Lead	Manganese	Mercury	Selenium	Silver	Sodium
QUALITY STANDARD ***			.025	1.0	.01	.05	.30	.025	.30	.002	.01	.05	<20
WNW80-06	DOWN	05/24/89	<.005	< .06	<.005	.026	.68	<.005	6.0	<.0004	<.005	<.005	11.0
WNW80-06	DOWN	06/12/89	<.005	< .06	<.005	.020	.45	<.005	7.6	<.0004	<.005	<.005	9.0
WNW80-06	DOWN	06/19/89	.019	< .06	.014	<.010	.32	<.005	6.7	<.0004	<.005	<.005	12.0
WNW80-06	DOWN	06/26/89	.013	.08	.006	<.010	.23	.005	3.7	<.0004	<.005	<.005	12.0
WNW80-06	DOWN	10/23/89	<.005	.16	.010	<.010	.48	.039	8.4	<.0004	<.005	<.005	18.0
WNW80-06	DOWN	11/13/89	<.005	.14	.006	<.010	.10	.017	4.2	<.0004	<.005	<.005	13.0
WNW80-06	DOWN	12/18/89	<.005	.07	<.005	.014	.96	.014	5.4	<.0004	<.005	<.010	11.0
WNW80-06	DOWN	12/18/89	<.005	.06	<.005	.013	.75	.013	6.1	<.0004	<.005	<.010	11.0
WNW86-03	DOWN	06/05/89	<.005	.08	.007	.026	1.6	<.005	.055	<.0004	<.005	<.005	24.0
WNW86-03	DOWN	06/12/89	<.005	.10	<.005	.026	.58	<.005	.047	<.0004	<.005	<.005	25.0
WNW86-03	DOWN	06/20/89	.015	.22	.013	<.010	1.7	<.005	.055	<.0004	<.005	<.005	25.0
WNW86-03	DOWN	06/28/89	<.005	.19	.007	<.010	2.6	<.005	.068	<.0004	<.005	.006	25.0
WNW86-03	DOWN	09/27/89	<.005	.20	.009	<.010	.99	<.005	.033	<.0004	<.005	.006	26.0
WNW86-03	DOWN	10/18/89	<.005	.07	.011	<.010	3.4	<.005	.11	.0005	<.005	.014	31.0
WNW86-03	DOWN	12/11/89	<.005	.26	.009	.013	2.5	.007	.069	.0010	<.005	<.010	27.0
WNW86-03	DOWN	12/11/89	<.005	.26	.005	.011	7.2	.011	.15	.0006	<.005	<.010	27.0
WNW86-04	DOWN	06/05/89	.011	.48	.006	.033	17.0	.034	.27	<.0004	<.005	.006	25.0
WNW86-04	DOWN	06/12/89	<.005	< .06	<.005	.018	.67	<.005	.041	<.0004	<.005	<.005	29.0
WNW86-04	DOWN	06/20/89	<.005	.24	.005	.026	4.9	.007	.14	<.0004	<.005	<.005	26.0
WNW86-04	DOWN	06/28/89	.008	.24	.010	.011	8.7	.008	.22	<.0004	<.005	<.005	25.0
WNW86-04	DOWN	09/27/89	<.005	.25	.011	<.010	14.0	.005	.23	.0028	<.005	.007	27.0
WNW86-04	DOWN	10/18/89	<.005	.11	.015	.012	22.0	.008	.38	<.0004	<.005	.007	32.0
WNW86-04	DOWN	12/11/89	<.005	.25	.014	.014	15.0	.010	.26	.0009	<.005	<.010	29.0
WNW86-04	DOWN	12/11/89	<.005	.26	<.005	.019	8.7	.009	.18	.0006	<.005	<.010	28.0
WNW86-05	DOWN	06/12/89	.008	.123	.004	.042	7.60	.006	8.41	.0005	<.002	.024	52.6
WNW86-05	DOWN	06/16/89	.008	.104	.005	.036	4.29	.005	7.99	<.0002	<.002	.249	50.7
WNW86-05	DOWN	06/22/89	.008	.087	<.002	.039	3.51	.003	5.68	.0003	<.002	.019	27.8
WNW86-05	DOWN	06/26/89	.011	.113	<.002	.050	5.53	.004	8.52	.0006	<.002	.024	44.1
WNW86-05	DOWN	10/03/89	.010	.135	.004	.052	5.18	<.002	11.9	<.0002	<.002	.028	88.2
WNW86-05	DOWN	12/13/89	.008	.138	<.002	.027	5.19	<.002	12.1	<.0002	<.002	.019	62.1
WNW86-05	DOWN	12/14/89	.010	.141	<.002	.030	6.20	<.002	12.4	<.0002	<.002	.020	62.9
WNW86-05	DOWN	12/18/89	.008	.148	<.002	.034	6.06	<.004	13.2	<.0002	<.002	.021	67.9

*** Quality Standards for Class GA Groundwater, from 6 NYCRR Part 703.5

Table E-9

1989 Dissolved Metals for Low-Level Radioactive Waste Lagoon System Groundwater Monitoring Unit (mg/L)

Location Code	Hydraulic Position	Sample Date	Arsenic	Barium	Cadmium	Chromium	Iron	Lead	Manganese	Mercury	Selenium	Silver	Sodium
QUALITY STANDARD ***			.025	1.0	.01	.05	.30	.025	.30	.002	.01	.05	<20
WNW86-06	UP	06/05/89	<.005	< .06	<.005	< .010	< .05	<.005	1.4	<.0004	<.005	<.005	480
WNW86-06	UP	06/13/89	<.005	< .06	<.005	< .010	< .05	<.005	1.7	<.0004	<.005	<.005	520
WNW86-06	UP	06/21/89	<.005	< .06	.006	.011	< .03	<.005	1.9	<.0004	<.005	.008	600
WNW86-06	UP	06/28/89	<.005	< .06	<.005	< .010	< .03	<.005	1.5	<.0004	<.005	<.005	530
WNW86-06	UP	09/26/89	<.005	< .05	.008	< .010	.03	<.005	.61	<.0004	<.005	<.005	120
WNW86-06	UP	10/26/89	<.005	< .05	<.005	< .010	.03	<.005	.93	<.0004	<.005	<.005	140
WNW86-06	UP	12/13/89	<.005	.07	<.005	< .010	< .05	<.005	1.5	<.0004	<.005	<.010	270
WNW86-06	UP	12/13/89	<.005	.08	<.005	< .010	< .05	<.005	1.7	<.0004	<.005	<.010	280
WNGSEEP	DOWN	06/08/89	<.005	< .06	<.005	< .010	< .05	<.005	.009	<.0004	<.005	<.005	12.0
WNGSEEP	DOWN	06/19/89	<.005	.11	<.005	< .010	< .03	<.005	< .010	<.0004	<.005	<.005	14.0
WNGSEEP	DOWN	06/22/89	<.005	< .06	<.005	< .010	< .03	<.005	< .010	<.0004	<.005	<.005	14.0
WNGSEEP	DOWN	06/28/89	<.005	< .06	.008	< .010	< .03	<.005	< .010	<.0004	<.005	<.005	14.0
WNGSEEP	DOWN	10/04/89	<.005	.14	.006	< .010	.03	<.005	< .010	<.0004	<.005	<.005	16.0
WNGSEEP	DOWN	10/23/89	<.005	.10	<.005	< .010	< .03	<.005	< .010	<.0004	<.005	<.005	11.0
WNGSEEP	DOWN	12/11/89	<.005	.11	<.005	< .010	< .05	<.005	< .005	<.0004	<.005	<.010	13.0
WNGSEEP	DOWN	12/11/89	<.005	.11	<.005	< .010	< .05	<.005	< .005	<.0004	<.005	<.010	13.0
WNSP008	DOWN	06/08/89	<.005	< .06	<.005	< .010	< .05	<.005	2.2	<.0004	<.005	<.005	46.0
WNSP008	DOWN	06/13/89	<.005	< .06	<.005	< .010	< .05	<.005	2.2	<.0004	<.005	<.005	46.0
WNSP008	DOWN	06/22/89	<.005	< .06	<.005	< .010	< .03	<.005	1.8	<.0004	<.005	.007	41.0
WNSP008	DOWN	06/28/89	<.005	< .06	<.005	< .010	< .03	<.005	2.1	<.0004	<.005	<.005	49.0
WNSP008	DOWN	10/04/89	<.005	.07	<.005	< .010	.03	<.005	1.5	<.0004	<.005	<.005	53.0
WNSP008	DOWN	10/23/89	<.005	< .05	.009	< .010	.03	<.005	1.9	<.0004	<.005	<.005	45.0
WNSP008	DOWN	12/11/89	<.005	.08	<.005	< .010	< .05	<.005	1.8	<.0004	<.005	<.010	50.0
WNSP008	DOWN	12/11/89	<.005	.07	<.005	< .020	< .05	<.005	2.1	<.0004	<.005	<.010	47.0
WNW80-05	DOWN	05/24/89	<.005	< .06	<.005	< .010	.49	<.005	.036	<.0004	<.005	<.005	20.0
WNW80-05	DOWN	06/12/89	<.005	< .06	<.005	< .010	.54	<.005	.036	<.0004	<.005	<.005	21.0
WNW80-05	DOWN	06/19/89	<.005	< .06	<.005	< .010	.23	<.005	.010	<.0004	<.005	.016	22.0
WNW80-05	DOWN	06/26/89	<.005	< .06	<.005	< .010	.25	<.005	.018	<.0004	<.005	<.005	21.0
WNW80-05	DOWN	10/03/89	<.005	.15	.010	< .010	.28	<.005	.036	<.0004	<.005	.005	25.0
WNW80-05	DOWN	11/13/89	<.005	< .06	<.005	< .010	.28	<.005	.032	<.0004	<.005	<.005	30.0
WNW80-05	DOWN	12/18/89	<.005	.11	<.005	< .010	.29	<.005	.021	<.0004	<.005	<.010	24.0
WNW80-05	DOWN	12/18/89	<.005	.12	<.005	< .010	.17	<.005	.014	<.0004	<.005	<.010	23.0

*** Quality Standards for Class GA Groundwater from 6 NYCRR Part 703.5

Table E-9 *(continued)*

1989 Dissolved Metals for Low-Level Radioactive Waste Lagoon System Groundwater Monitoring Unit (mg/L)

Location Code	Hydraulic Position	Sample Date	Arsenic	Barium	Cadmium	Chromium	Iron	Lead	Manganese	Mercury	Selenium	Silver	Sodium
QUALITY STANDARD ***			.025	1.0	.01	.05	.30	.025	.30	.002	.01	.05	<20
WNW80-06	DOWN	05/24/89	<.005	< .06	<.005	.014	.32	<.005	6.1	<.0004	<.005	<.005	10.0
WNW80-06	DOWN	06/12/89	<.005	< .06	<.005	< .010	.37	<.005	7.9	<.0004	<.005	<.005	9.0
WNW80-06	DOWN	06/19/89	<.005	< .06	<.005	< .010	.031	<.005	6.7	<.0004	<.005	<.005	12.0
WNW80-06	DOWN	06/26/89	<.005	< .06	<.005	< .010	.32	<.005	5.3	<.0004	<.005	<.005	12.0
WNW80-06	DOWN	10/23/89	<.005	< .06	<.005	< .010	.20	<.005	6.7	<.0004	<.005	<.005	12.0
WNW80-06	DOWN	11/13/89	<.005	< .06	<.005	< .010	< .05	<.005	3.7	<.0004	<.005	<.005	12.0
WNW80-06	DOWN	12/18/89	<.005	.06	<.005	.014	.24	<.005	3.0	<.0004	<.005	<.010	9.3
WNW80-06	DOWN	12/18/89	<.005	< .06	<.005	< .010	.20	<.005	5.0	<.0004	<.005	<.010	9.1
WNW86-03	DOWN	06/05/89	<.005	< .06	<.005	< .010	< .05	<.005	.014	<.0004	<.005	<.005	23.0
WNW86-03	DOWN	06/12/89	<.005	< .06	<.005	< .010	< .05	<.005	.008	<.0004	<.005	<.005	25.0
WNW86-03	DOWN	06/20/89	<.005	< .06	<.005	< .010	< .03	<.005	< .010	<.0004	<.005	<.005	24.0
WNW86-03	DOWN	06/28/89	<.005	< .06	<.005	< .010	.03	<.005	< .010	<.0004	<.005	<.005	26.0
WNW86-03	DOWN	09/27/89	<.005	.20	.009	< .010	< .03	<.005	.010	<.0004	<.005	.006	24.0
WNW86-03	DOWN	10/18/89	<.005	< .06	.007	< .010	< .03	<.005	.012	<.0004	<.005	<.005	24.0
WNW86-03	DOWN	12/11/89	<.005	.24	<.005	< .010	< .05	.006	.006	<.0004	<.005	<.010	23.0
WNW86-03	DOWN	12/11/89	<.005	.23	<.005	.011	< .05	<.005	< .005	<.0004	<.005	<.010	25.0
WNW86-04	DOWN	06/05/89	<.005	< .06	<.005	< .010	< .05	<.005	.043	<.0004	<.005	<.005	23.0
WNW86-04	DOWN	06/12/89	<.005	< .06	<.005	< .010	< .05	<.005	.034	<.0004	<.005	<.005	25.0
WNW86-04	DOWN	06/20/89	<.005	.18	.006	< .010	.05	<.005	.024	<.0004	<.005	<.005	26.0
WNW86-04	DOWN	06/28/89	<.005	< .06	<.005	< .010	.03	<.005	.028	<.0004	<.005	.006	25.0
WNW86-04	DOWN	09/27/89	<.005	.17	<.005	< .010	.04	<.005	.034	<.0004	<.005	<.005	22.0
WNW86-04	DOWN	10/18/89	<.005	< .06	.008	< .010	< .03	<.005	.036	<.0004	<.005	<.005	25.0
WNW86-04	DOWN	12/11/89	<.005	.20	<.005	.012	< .05	<.005	.029	<.0004	<.005	<.010	27.0
WNW86-04	DOWN	12/11/89	<.005	.26	<.005	.015	.06	<.005	.045	.0005	<.005	<.010	24.0
WNW86-05	DOWN	06/12/89	.008	.142	.048	.045	4.62	<.002	9.14	.0003	<.002	.025	58.7
WNW86-05	DOWN	06/16/89	.008	.111	.004	.036	4.32	.002	8.59	<.0002	<.002	.026	54.4
WNW86-05	DOWN	06/22/89	.009	.087	<.002	.041	3.09	<.002	6.48	.0005	<.002	.020	32.2
WNW86-05	DOWN	06/26/89	.010	.108	.004	.050	4.49	<.002	8.65	.0002	<.002	.025	45.4
WNW86-05	DOWN	10/03/89	.010	.137	.003	.051	5.05	<.002	12.10	<.0002	<.002	.028	89.6
WNW86-05	DOWN	12/13/89	.008	.132	<.002	.028	4.92	<.002	11.90	<.0002	<.002	.019	61.4
WNW86-05	DOWN	12/14/89	.007	.137	<.002	.029	5.14	<.002	12.50	<.0002	<.002	.021	63.3
WNW86-05	DOWN	12/18/89	.007	.149	<.002	.033	5.65	<.002	13.50	<.0002	<.002	.022	69.9

Table E - 10

1989 Radioactivity Concentrations in the Low-Level Radioactive Waste Lagoon System Groundwater Monitoring Unit (μCi/mL)

Location Code	Hydraulic Position	Sample Date	Gross Alpha	Gross Beta	Tritium	Cs-137	Co-60
DOE DCGs			3.0E-08	1.0E-06	2.0E-03	3E-06	5E-06
Quality Standard***			1.5E-08	1.0E-06	2.0E-05	N/A	N/A
WNW86-06	UP	06/05/89	<1.09E-08	5.99E-09 ± 5.18E−09	<1E-7	<1.1E-08	<1.4E-08
WNW86-06	UP	06/13/89	<2.98E-09	1.03E-08 ± 5.96E−09	<1E-7	<3.7E-08	<3.8E-08
WNW86-06	UP	06/21/89	<1.05E-08	1.61E-08 ± 6.89E−09	<1E-7	<3.7E-08	<3.8E-08
WNW86-06	UP	06/28/89	<1.18E-08	1.00E-08 ± 6.00E−09	<1E-7	<3.7E-08	<3.8E-08
WNW86-06	UP	09/26/89	4.60E-09 ± 4.02E−09	<3.94E-09	<1E-7	<3.7E-08	<3.8E-08
WNW86-06	UP	10/26/89	<4.46E-09	<4.19E-09	<1E-7	<3.7E-08	<3.8E-08
WNW86-06	UP	12/13/89	<8.54E-09	5.05E-09 ± 4.89E−09	<1.18E-7	<3.7E-08	<3.8E-08
WNW86-06	UP	12/13/89	<4.30E-09	1.08E-08 ± 5.62E−09	<1E-7	<3.7E-08	<3.8E-08
WNGSEEP	DOWN	06/08/89	<1.85E-09	3.20E-09 ± 1.45E−09	8.94E-7 ± 1.39E-7	<1.1E-08	<1.4E-08
WNGSEEP	DOWN	06/19/89	<1.42E-09	1.34E-09 ± 1.22E−09	1.05E-6 ± 1.39E-7	<3.7E-08	<3.8E-08
WNGSEEP	DOWN	06/22/89	<2.33E-09	3.13E-09 ± 1.48E−09	1.05E-6 ± 1.46E-7	<3.7E-08	<3.8E-08
WNGSEEP	DOWN	06/28/89	<1.76E-09	4.08E-09 ± 1.60E−09	1.10E-6 ± 1.39E-7	<3.7E-08	<3.8E-08
WNGSEEP	DOWN	10/04/89	<2.72E-09	6.26E-09 ± 1.87E−09	1.43E-6 ± 1.33E-7	<3.7E-08	<3.8E-08
WNGSEEP	DOWN	10/23/89	<2.55E-09	3.73E-09 ± 1.62E−09	1.65E-6 ± 1.41E-7	<3.7E-08	<3.8E-08
WNGSEEP	DOWN	12/11/89	<1.56E-09	4.20E-09 ± 1.64E−09	1.45E-6 ± 1.37E-7	<3.7E-08	<3.8E-08
WNGSEEP	DOWN	12/11/89	<1.29E-09	3.62E-09 ± 1.55E−09	1.42E-6 ± 1.35E-7	<3.7E-08	<3.8E-08
WNSP008	DOWN	06/08/89	<1.50E-09	4.21E-08 ± 4.41E−09	6.34E-6 ± 2.93E-7	<1.1E-08	<1.4E-08
WNSP008	DOWN	06/13/89	<6.38E-09	5.11E-08 ± 4.76E−09	5.25E-6 ± 2.48E-7	<3.7E-08	<3.8E-08
WNSP008	DOWN	06/22/89	<4.24E-09	4.43E-08 ± 4.35E−09	5.68E-6 ± 2.78E-7	<3.7E-08	<3.8E-08
WNSP008	DOWN	06/28/89	<4.40E-09	5.53E-08 ± 5.78E−09	6.62E-6 ± 2.84E-7	<3.7E-08	<3.8E-08
WNSP008	DOWN	10/04/89	<5.30E-09	4.05E-08 ± 4.92E−09	6.30E-6 ± 2.62E-7	<3.7E-08	<3.8E-08
WNSP008	DOWN	10/23/89	<3.18E-09	4.60E-08 ± 5.17E−09	5.67E-6 ± 2.54E-7	<3.7E-08	<3.8E-08
WNSP008	DOWN	12/11/89	<7.21E-10	4.58E-08 ± 5.08E−09	6.67E-6 ± 2.76E-7	<3.7E-08	<3.8E-08
WNSP008	DOWN	12/11/89	5.43E-09 ± 5.28E−09	4.93E-08 ± 5.33E-09	6.32E-6 ± 2.66E-7	<3.7E-08	<3.8E-08
WNW80-05	DOWN	05/24/89	<6.00E-10	3.35E-09 ± 1.55E−09	6.50E-7 ± 1.37E-7	<1.1E-08	<1.4E-08
WNW80-05	DOWN	06/12/89	<2.74E-09	2.37E-09 ± 1.47E−09	9.08E-7 ± 1.37E-7	<3.7E-08	<3.8E-08
WNW80-05	DOWN	06/19/89	<2.75E-09	2.21E-09 ± 1.42E−09	7.23E-7 ± 1.32E-7	<3.7E-08	<3.8E-08
WNW80-05	DOWN	06/26/89	<1.45E-09	1.78E-09 ± 1.34E−09	2.62E-7 ± 1.21E-7	<3.7E-08	<3.8E-08
WNW80-05	DOWN	10/03/89	<7.83E-09	5.11E-09 ± 1.97E−09	1.39E-6 ± 1.33E-7	<3.7E-08	<3.8E-08
WNW80-05	DOWN	11/13/89	<8.86E-09	4.07E-09 ± 1.85E−09	1.27E-6 ± 1.50E-7	<3.7E-08	<3.8E-08
WNW80-05	DOWN	12/18/89	<3.19E-09	3.62E-09 ± 1.71E−09	9.20E-7 ± 1.27E-7	<3.7E-08	<3.8E-08
WNW80-05	DOWN	12/18/89	<1.02E-09	4.26E-09 ± 1.75E−09	8.36E-7 ± 1.23E-7	<3.7E-08	<3.8E-08

*** Quality Standards for Class GA Groundwater, from 6 NYCRR Part 703.5 N/A Not available

1989 Radioactivity Concentrations in the Low-Level Radioactive Waste Lagoon System Groundwater Monitoring Unit (μCi/mL)

Location Code	Hydraulic Position	Sample Date	Gross Alpha	Gross Beta	Tritium	Cs-137	Co-60
DOE DCGs			3.0E-08	1.0E-06	2.0E-03	3E-06	5E-06
Quality Standard***			1.5E-08	1.0E-06	2.0E-05	N/A	N/A
WNW80-06	DOWN	05/24/89	<2.82E-09	3.98E-09 ± 1.61E−09	1.22E-6 ± 1.52E-7	<1.1E-08	<1.4E-08
WNW80-06	DOWN	06/12/89	<1.98E-09	3.58E-09 ± 1.56E−09	5.48E-7 ± 1.66E-7	<3.7E-08	<3.8E-08
WNW80-06	DOWN	06/19/89	<4.03E-09	2.75E-09 ± 1.55E−09	1.26E-6 ± 1.44E-7	<3.7E-08	<3.8E-08
WNW80-06	DOWN	06/26/89	<7.83E-10	4.59E-09 ± 1.74E−09	1.05E-6 ± 1.39E-7	<3.7E-08	<3.8E-08
WNW80-06	DOWN	10/23/89	<7.66E-09	7.13E-09 ± 2.18E−09	2.62E-7 ± 1.56E-7	<3.7E-08	<3.8E-08
WNW80-06	DOWN	11/13/89	<2.28E-09	3.94E-09 ± 1.69E−09	2.95E-7 ± 1.61E-7	<3.7E-08	<3.8E-08
WNW80-06	DOWN	12/18/89	<9.13E-10	4.18E-09 ± 1.72E−09	7.95E-7 ± 1.37E-7	<3.7E-08	<3.8E-08
WNW80-06	DOWN	12/18/89	<4.44E-09	4.23E-09 ± 1.88E−09	9.09E-7 ± 1.48E-7	<3.7E-08	<3.8E-08
WNW86-03	DOWN	06/05/89	<2.96E-09	7.95E-09 ± 2.45E−09	1.27E-6 ±1.51E-7	<1.1E-08	<1.4E-08
WNW86-03	DOWN	06/12/89	<1.36E-09	8.93E-09 ± 2.29E−09	8.57E-7 ±1.34E-7	<3.7E-08	<3.8E-08
WNW86-03	DOWN	06/20/89	<2.24E-09	1.33E-08 ± 2.95E−09	1.07E-6 ±1.38E-7	<3.7E-08	<3.8E-08
WNW86-03	DOWN	06/28/89	<1.10E-09	1.08E-08 ± 2.41E−09	9.91E-7 ±1.37E-7	<3.7E-08	<3.8E-08
WNW86-03	DOWN	09/27/89	<6.12E-09	8.45E-09 ± 2.58E−09	1.15E-6 ±1.35E-7	<3.7E-08	<3.8E-08
WNW86-03	DOWN	10/18/89	<7.89E-10	1.01E-08 ± 2.65E−09	1.32E-6 ±1.32E−7	<3.7E-08	<3.8E-08
WNW86-03	DOWN	12/11/89	<5.19E-09	1.33E-08 ± 3.05E−09	1.10E-6 ±1.29E-7	<3.7E-08	<3.8E-08
WNW86-03	DOWN	12/11/89	<3.98E-09	1.32E-08 ± 2.90E−09	1.12E-6 ±1.27E-7	<3.7E-08	<3.8E-08
WNW86-04	DOWN	06/05/89	<2.70E-09	7.16E-08 ±5.48E−09	1.44E-6 ±1.54E-7	<1.1E-08	<1.4E-08
WNW86-04	DOWN	06/12/89	<5.23E-09	9.31E-08 ±6.30E−09	1.10E-6 ±1.39E-7	<3.7E-08	<3.8E-08
WNW86-04	DOWN	06/20/89	<3.44E-09	8.63E-08 ±6.11E−09	1.26E-6 ±1.42E-7	<3.7E-08	<3.8E-08
WNW86-04	DOWN	06/28/89	<1.06E-09	8.44E-08 ±5.95E−09	1.24E-6 ±1.42E-7	<3.7E-08	<3.8E-08
WNW86-04	DOWN	09/27/89	<3.19E-09	7.31E-08 ±6.04E−09	1.62E-6 ±1.39E-7	<3.7E-08	<3.8E-08
WNW86-04	DOWN	10/18/89	<4.10E-09	7.75E-08 ±6.24E−09	1.56E-6 ±1.38E-7	<3.7E-08	<3.8E-08
WNW86-04	DOWN	12/11/89	<2.91E-09	8.75E-08 ±5.92E−09	1.31E-6 ±1.30E-7	<3.7E-08	<3.8E-08
WNW86-04	DOWN	12/11/89	<5.52E-09	8.25E-08 ±6.46E−09	1.31E-6 ±1.30E−7	<3.7E-08	<3.8E-08
WNW86-05	DOWN	06/12/89	1.13E-08 ±8.35E−09	3.39E-05 ±1.57E-07	2.52E-5 ±8.05E-7	<1.1E-08	<1.4E-08
WNW86-05	DOWN	06/16/89	6.13E-09 ±5.97E−09	3.10E-05 ±1.49E−07	1.85E-5 ±6.16E-7	<3.7E-08	<3.8E-08
WNW86-05	DOWN	06/22/89	6.93E-09 ±5.14E−09	2.32E-05 ±1.26E−07	9.11E-6 ± 3.49E-7	<3.7E-08	<3.8E-08
WNW86-05	DOWN	06/26/89	1.15E-08 ±7.52E−09	3.04E-05 ±1.47E-07	1.61E-5 ±5.46E−7	<3.7E-08	<3.8E-08
WNW86-05	DOWN	10/03/89	<6.14E-09	3.74E-05 ±1.65E−07	1.46E-5 ±5.04E-7	<3.7E-08	<3.8E-08
WNW86-05	DOWN	12/13/89	8.13E-09 ±6.51E−09	3.83E-05 ± .65E-07	1.85E-5 ±6.15E-7	<3.7E-08	<3.8E-08
WNW86-05	DOWN	12/14/89	1.48E-08 ±8.79E−09	4.03E-05 ±1.70E-07	1.93E-5 ±6.37E-7	<3.7E-08	<3.8E-08
WNW86-05	DOWN	12/18/89	1.43E-08 ±9.33E−09	4.55E-05 ± 1.83E-07	2.07E-5 ±6.77E-7	<3.7E-08	<3.8E-08

*** Quality Standards for Class GA Groundwater, from 6 NYCRR Part 703.5 N/A Not available

Table E - 11

1989 Water Quality Parameters for NRC-Licensed Disposal Area Groundwater Monitoring Unit (mg/L)

Location Code	Hydraulic Position	Sample Date	pH	Conductivity*	TOC	Phenols	TOX	Chloride	Nitrate-N	Sulfate	Fluoride
QUALITY STANDARDS ***			6.5-8.5	N/A	N/A	.001	N/A	250	10	250	1.5
WNW83-1D	UP	06/07/89	7.85	290	< 1.0	<.007	<.010	6.2	<.05	78	.43
WNW83-1D	UP	06/14/89	7.63	289	21.0	<.007	<.010	5.6	<.05	90	.44
WNW83-1D	UP	06/22/89	7.86	289	< 1.0	<.008	<.010	5.9	<.05	32	.40
WNW83-1D	UP	06/23/89	7.73	287	2.0	<.007	<.010	6.4	<.05	24	.44
WNW83-1D	UP	10/10/89	7.66	289	4.6	<.008	<.010	6.1	<.05	55	.40
WNW83-1D	UP	12/12/89	7.93	294	3.0	<.008	<.005	1.2	.056	3.6	.41
WNW83-1D	UP	12/18/89	7.79	288	2.5	<.008	0.020	6.7	<.05	11	.35
WNW83-1D	UP	12/21/89	7.88	295	7.0	<.008	.020	6.5	<.05	46	.36
WNW86-10	DOWN	06/07/89	7.97	672	1.5	<.007	.011	<2.0	<.05	130	.14
WNW86-10	DOWN	06/14/89	7.70	697	< 1.0	<.006	<.010	<2.0	<.05	130	.15
WNW86-10	DOWN	06/21/89	8.06	683	< 1.0	.071	<.010	<2.0	<.05	65	.14
WNW86-10	DOWN	06/23/89	8.11	628	< 1.0	<.020	<.010	<2.0	.051	80	.16
WNW86-10	DOWN	10/12/89	8.27	649	4.0	<.008	<.010	<1.0	.087	64	.15
WNW86-10	DOWN	12/12/89	8.63	654	1.0	<.008	.027	<1.0	<.05	95	.16
WNW86-10	DOWN	12/13/89	8.53	646	1.7	<.008	<.005	<1.0	<.05	80	.15
WNW86-10	DOWN	12/14/89	8.14	648	< 1.0	<.008	<.005	<1.0	.053	92	.12
WNW86-11	DOWN	06/07/89	7.55	756	< 1.0	<.007	<.010	<2.0	<.05	33	.16
WNW86-11	DOWN	06/15/89	7.80	710	2.4	<.005	<.010	<2.0	.086	120	.18
WNW86-11	DOWN	06/19/89	8.03	674	< 1.0	.058	<.010	<2.0	<.05	130	.16
WNW86-11	DOWN			*** Sample not available***							
WNW86-11	DOWN	10/12/89	7.81	769	2.9	<.008	<.010	<1.0	.30	150	.19
WNW86-11	DOWN	12/12/89	7.73	823	3.2	<.008	<.005	<1.0	.15	190	.19
WNW86-11	DOWN	12/13/89	7.84	805	12.0	.010	<.005	1.4	.29	170	.16
WNW86-11	DOWN	12/14/89	7.91	770	15.0	<.008	<.005	<1.0	.19	180	.15

* in μmhos/cm @25°C

*** Quality Standards for Class GA Groundwaters from 6 NYCRR Part 703.5

Table E - 12

1989 Total Metals for NRC-Licensed Disposal Area Groundwater Monitoring Unit (mg/L)

Location Code	Hydraulic Position	Sample Date	Arsenic	Barium	Cadmium	Chromium	Iron	Lead	Manganese	Mercury	Selenium	Silver	Sodium
QUALITY STANDARD ***			.025	1.0	.01	.05	.30	.025	.30	.002	.01	.05	<20
WNW83-1D	UP	06/07/89	.007	.59	<.005	.026	9.9	.006	.19	<.0004	<.005	<.005	22.0
WNW83-1D	UP	06/14/89	<.005	.80	.014	.011	5.9	.007	.18	<.0004	<.005	<.005	22.0
WNW83-1D	UP	06/22/89	<.005	.81	.016	.018	17.0	.017	.29	<.0004	<.005	<.005	21.0
WNW83-1D	UP	06/23/89	<.005	.91	<.005	<.010	5.9	.007	.17	<.0004	<.005	<.005	22.0
WNW83-1D	UP	10/10/89	<.005	.78	.005	<.010	13.0	.006	.22	<.0004	<.005	<.005	21.0
WNW83-1D	UP	12/12/89	<.005	.76	<.005	.046	22.0	.016	.26	<.0004	<.005	<.010	22.0
WNW83-1D	UP	12/18/89	<.005	.80	<.005	.017	11.0	..037	.20	<.0004	<.005	<.010	22.0
WNW83-1D	UP	12/21/89	<.005	.79	.007	.040	18.0	.020	.25	<.0004	<.005	<.010	19.0
WNW86-10	DOWN	06/07/89	<.005	< .06	<.005	.078	4.6	.011	.15	<.0004	<.005	.010	65.0
WNW86-10	DOWN	06/14/89	<.005	.12	.006	.040	4.2	.032	.18	<.0004	<.005	.016	72.0
WNW86-10	DOWN	06/21/89	.010	.13	.011	.055	9.3	.041	.27	<.0004	<.005	<.005	70.0
WNW86-10	DOWN	06/23/89	.009	< .06	<.005	.039	7.4	.036	.43	<.0004	<.005	.005	64.0
WNW86-10	DOWN	10/12/89	<.005	.58	.008	<.010	1.4	<.005	.066	<.0004	<.005	<.005	69.0
WNW86-10	DOWN	12/12/89	<.005	< .06	<.005	.071	4.9	<.005	.11	<.0004	<.005	<.010	78.0
WNW86-10	DOWN	12/13/89	<.005	.07	<.005	.055	1.0	.009	.064	<.0004	<.005	<.010	77.0
WNW86-10	DOWN	12/14/89	<.005	.09	<.005	.077	3.4	.011	.096	<.0004	<.005	<.010	69.0
WNW86-11	DOWN	06/07/89	.006	< .06	<.005	.120	14.0	.024	.360	<.0004	<.005	<.006	60.0
WNW86-11	DOWN	06/15/89	.011	.17	.009	.110	32.0	.047	.760	<.0004	<.005	.027	58.0
WNW86-11	DOWN	06/19/89	.011	.07	.009	.066	11.0	.039	.260	<.0004	<.005	.009	59.0
WNW86-11	DOWN	06/23/89	** SAMPLE NOT AVAILABLE **										
WNW86-11	DOWN	10/12/89	<.005	.15	.014	.150	29.0	.028	.630	<.0004	<.005	.009	64.0
WNW86-11	DOWN	12/12/89	.007	.09	<.005	.097	18.0	.010	.410	<.0004	<.005	<.010	64.0
WNW86-11	DOWN	12/13/89	<.005	.07	<.005	.027	3.4	.026	.230	<.0004	<.005	<.010	54.0
WNW86-11	DOWN	12/14/89	<.005	.06	<.005	.031	2.2	.018	.170	<.0004	<.005	<.010	62.0

***Quality Standards for Class GA Groundwater from 6 NYCRR Part 703.5

Table E - 13

1989 Dissolved Metals for NRC-Licensed Disposal Area Groundwater Monitoring Unit (mg/L)

Location Code	Hydraulic Position	Sample Date	Arsenic	Barium	Cadmium	Chromium	Iron	Lead	Manganese	Mercury	Selenium	Silver	Sodium
QUALITY STANDARD ***			.025	1.0	.01	.05	.30	.025	.30	.002	.01	.05	<20
WNW83-1D	UP	06/07/89	<.005	< .06	<.005	< .010	< .05	<.005	.12	<.0004	<.005	<.005	21.0
WNW83-1D	UP	06/14/89	<.005	.76	<.005	< .010	< .03	<.005	.11	<.0004	<.005	<.005	22.0
WNW83-1D	UP	06/22/89	<.005	< .06	.005	< .010	< .03	<.005	.12	<.0004	<.005	<.005	23.0
WNW83-1D	UP	06/23/89	<.005	< .06	<.005	< .010	< .03	<.005	.11	<.0004	<.005	<.005	22.0
WNW83-1D	UP	10/10/89	<.005	.78	<.005	< .010	.05	<.005	.11	<.0004	<.005	<.005	18.0
WNW83-1D	UP	12/12/89	<.005	.65	<.005	< .010	< .05	<.005	.12	<.0004	<.005	<.010	20.0
WNW83-1D	UP	12/18/89	<.005	.71	<.005	< .010	< .05	<.005	.10	<.0004	<.005	<.010	19.0
WNW83-1D	UP	12/21/89	<.005	.68	<.005	.010	< .05	<.005	.13	<.0004	<.005	<.010	22.0
WNW86-10	DOWN	06/07/89	<.005	< .06	<.005	< .010	< .05	<.005	.068	<.0004	<.005	<.005	62.0
WNW86-10	DOWN	06/14/89	<.005	< .06	<.005	< .010	< .03	<.005	.10	<.0004	<.005	<.005	72.0
WNW86-10	DOWN	06/21/89	<.005	.10	<.005	< .010	< .03	<.005	.070	<.0004	<.005	<.005	70.0
WNW86-10	DOWN	06/23/89	.008	.21	.011	< .010	< .03	<.005	.075	<.0004	<.005	<.005	64.0
WNW86-10	DOWN	10/12/89	<.005	.06	<.005	< .010	< .03	<.005	.040	<.0004	<.005	<.005	67.0
WNW86-10	DOWN	12/12/89	<.005	< .06	<.005	.013	.46	<.005	.057	<.0004	<.005	<.010	72.0
WNW86-10	DOWN	12/13/89	<.005	< .06	<.005	< .010	.12	<.005	<.06	<.0004	<.005	<.010	61.0
WNW86-10	DOWN	12/14/89	<.005	.07	<.005	< .010	< .05	<.005	.035	<.0004	<.005	<.010	56.0
WNW86-11	DOWN	06/07/89	<.005	< .06	<.005	< .010	< .05	<.005	.12	<.0004	<.005	<.005	57.0
WNW86-11	DOWN	06/15/89	<.005	< .06	<.005	< .010	< .03	<.005	.048	<.0004	<.005	<.005	61.0
WNW86-11	DOWN	06/19/89	<.005	.07	<.005	< .010	.03	<.005	.048	<.0004	<.005	<.005	60.0
WNW86-11	DOWN	06/23/89	** SAMPLE NOT AVAILABLE **										
WNW86-11	DOWN	10/12/89	<.005	< .05	.006	< .010	< .03	<.005	.14	<.0004	<.005	<.005	59.0
WNW86-11	DOWN	12/12/89	<.005	< .06	<.005	.011	.99	<.005	.22	<.0004	<.005	<.010	56.0
WNW86-11	DOWN	12/13/89	<.005	< .06	<.005	< .010	< .05	<.005	<.06	<.0004	<.005	<.010	54.0
WNW86-11	DOWN	12/14/89	<.005	< .06	<.005	< .010	< .05	<.005	.092	<.0004	<.005	<.010	52.0

*** Quality Standards for Class GA Groundwater from 6 NYCRR Part 703.5

Table E-14.

1989 Radioactivity Concentrations for Groundwater in the NRC-Licensed Disposal Area Groundwater Monitoring Unit (μCi//mL)

Location Code	Hydraulic Position	Sample Date	Gross Alpha	Gross Beta	Tritium	Cs-137	Co-60
DOE DCGs			3.0E-08	1.0E-06	2.0E-03	3E-06	5E-06
Quality Standard***			1.5E-08	1.0E-06	2.0E-05	N/A	N/A
WNW83-1D	UP	06/07/89	<1.11E-09	3.79E-09 ± 1.46E−09	<1E-7	<1.1E-08	<1.4E-08
WNW83-1D	UP	06/14/89	<1.29E-09	2.99E-09 ± 1.36E−09	<1E-7	<3.7E-08	<3.8E-08
WNW83-1D	UP	06/22/89	<9.09E-10	5.39E-09 ± 1.63E−09	<1E-7	<3.7E-08	<3.8E-08
WNW83-1D	UP	06/23/89	<1.02E-09	2.83E-09 ± 1.34E−09	<1E-7	<3.7E-08	<3.8E-08
WNW83-1D	UP	10/10/89	<1.26E-09	1.57E-09 ± 1.17E−09	<1E-7	<3.7E-08	<3.8E-08
WNW83-1D	UP	11/20/89	<2.23E-10	2.56E-09 ± 1.30E−09	<1E-7	<3.7E-08	<3.8E-08
WNW83-1D	UP	12/12/89	<1.08E-09	3.52E-09 ± 1.43E−09	<1E-7	<3.7E-08	<3.8E-08
WNW83-1D	UP	12/21/89	<7.98E-10	3.01E-09 ± 1.39E−09	<1E-7	<3.7E-08	<3.8E-08
WNW86-10	DOWN	06/07/89	<2.05E-09	7.22E-09 ± 1.95E−09	<1E-7	<1.1E-08	<1.4E-08
WNW86-10	DOWN	06/14/89	<2.04E-09	7.79E-09 ± 2.00E−09	<1E-7	<3.7E-08	<3.8E-08
WNW86-10	DOWN	06/21/89	<7.17E-10	9.36E-09 ± 2.19E−09	1.49E-7 ± 1.05E−7	<3.7E-08	<3.8E-08
WNW86-10	DOWN	06/23/89	<1.71E-09	7.37E-09 ± 1.99E−09	<1.03E-7	<3.7E-09	<3.8E-08
WNW86-10	DOWN	10/12/89	<3.19E-09	6.47E-09 ± 1.88E−09	<1.05E-7	<3.7E-08	<3.8E-08
WNW86-10	DOWN	12/12/89	<2.29E-09	5.22E-09 ± 1.77E−09	<1.04E-7	<3.7E-08	<3.8E-08
WNW86-10	DOWN	12/13/89	<1.77E-09	6.62E-09 ± 1.92E−09	1.78E-7 ± 1.07E−7	<3.7E-08	<3.8E-08
WNW86-10	DOWN	12/14/89	<2.10E-09	7.97E-09 ± 2.08E−09	<1E-7	<3.7E-08	<3.8E-08
WNW86-11	DOWN	06/07/89	5.10E-09 ± 4.97E−09	4.72E-09 ± 1.76E−09	<1E-7	<1.1E-08	<1.4E-08
WNW86-11	DOWN	06/15/89	<2.54E-09	3.13E-09 ± 1.55E−09	<1E-7	<3.7E-08	<3.8E-08
WNW86-11	DOWN	06/19/89	<2.86E-09	3.64E-09 ± 1.56E−09	<1E-7	<3.7E-08	<3.8E-08
WNW86-11	DOWN	06/23/89		*** Sample not available***			
WNW86-11	DOWN	10/12/89	<3.89E-09	3.18E-09 ± 1.58E−09	<1E-7	<3.7E-08	<3.8E-08
WNW86-11	DOWN	12/12/89	7.02E-09 ± 6.14E−09	3.38E-09 ± 1.63E−09	1.80E-7 ± 1.06E−7	<3.7E-08	<3.8E-08
WNW86-11	DOWN	12/13/89	<2.75E-09	6.36E-09 ± 1.92E−09	2.39E-7 ± 1.08E−7	<3.7E-08	<3.8E-08
WNW86-11	DOWN	12/14/89	<2.77E-09	2.87E-09 ± 1.62E−09	<1.04E-7	<3.7E-08	<3.8E-08

*** Quality Standards for Class GA Groundwater, from 6 NYCRR Part 703.5

Table E - 15

Summary of Special NDA Well Sampling Positive Results

Analyte	NDA Well 85-I-9	NDA Well 89-5-N	NDA Well 89-14-E	Field Blank	Laboratory Blank	Groundwater Quality Standard (NYCRR)*
SEMIVOLATILE ORGANICS						
bis(2-ethylhexyl) phthalate [1]	300 .0 μg/L	320 .0 μg/L	< 10.0 μg/L	< 10.0 μg/L	< 10.0 μg/L	4.2 μg/L
tributyl phosphate [2]	< 10.0 μg/L	2.1E+5 μg/L	< 10.0 μg/L	< 10.0 μg/L	< 10.0 μug/L	not listed
VOLATILE ORGANICS						
trichlorofluoromethane	< 5.0 μg/L	38 .0 μg/L	44.0 μg/L	18.0 μg/L	36.0 μg/L	not listed
2-hexanone	< 10.0 μg/L	25.0 μg/L	< 10.0 μg/L	< 10.0 μg/L	< 10.0 μg/L	not listed
2-butanone [3]	< 10 .0 μg/L	14.0 μg/L	< 10.0 μg/L	< 10.0 μg/L	< 10.0 μg/L	not listed
METALS						
aluminum	423.0 μg/L	N/A	N/A	< 60.0 μg/L	91.6 μg/L	not listed
barium	67.3 μg/L	N/A	N/A	< 2.0 μg/L	< 2.0 μg/L	1,000 μg/L
boron	1,150 μg/L	N/A	N/A	< 30.0 μg/L	70.2 μg/L	not listed
cadmium	4.0 μg/L	N/A	N/A	< 2.0 μg/L	< 2.0 μg/L	10.0 μg/L
calcium	96,400 μg/L	N/A	N/A	43.4 μg/L	32.0 μg/L	not listed
chromium [5]	25.9 μg/L	N/A	N/A	< 10.0 μg/L	< 10.0 μg/L	50.0 μg/L
copper	11.3 μg/L	N/A	N/A	< 10.0 μg/L	< 10.0 μg/L	1,000 μg/L
iron	242.0 μg/L	N/A	N/A	< 10.0 μg/L	71.2 μg/L	300 μg/L
magnesium	54,800 μg/L	N/A	N/A	< 60.0 μg/L	< 60.0 μg/L	not listed
manganese	46.3 μg/L	N/A	N/A	< 2.0 μg/L	< 2.0μg/L	300 μg/L
molybdenum	11.2 μg/l	N/A	N/A	< 10.0 μg/L	< 10.0 μg/L	not listed
sodium	10,000 μg/L	N/A	N/A	< 100 μg/L	< 100 μg/L	< 20mg/L
titanium	26.5 μg/L	N/A	N/A	< 5.0 μg/L	< 5.0 μg/L	not listed
vanadium	18.1μg/L	N/A	N/A	< 10.0 μg/L	< 10.0 μg/L	5,000 μg/L
zinc	25.6μg/L	N/A	N/A	11.5 μg/L	19.9 μg/L	not listed
lead	2.2 μg/L	N/A	N/A	< 2.0 μg/L	< 2.0 μg/L	25.0 μg/L
potassium	2,060 μg/L	N/A	N/A	< 100 μg/L	< 100 μg/L	not listed
WATER QUALITY						
sulfate	50.0 mg/L	N/A	N/A	< 1.5 mg/L	< 1.5mg/L	250 mg/L
chloride	2.2 mg/L	N/A	N/A	< 0.5 mg/L	< 0.5 mg/L	250 mg/L
oil and grease	2.4 mg/L	N/A	N/A	< 0.10 mg/L	< 0.10 mg/L	not listed
Total Organic Carbon - TOC [4]	1.63 mg/L	N/A	N/A	1.1 mg/L	< 1.0 mg/L	not listed
C.O.D.	7.0 mg/L	N/A	N/A	< 2.0 mg/L	< 2.0 mg/L	not listed
phosphorous	0.042 mg/L	N/A	N/A	< 0.02 mg/L	< 0.02 mg/L	not listed
Total Suspended Solids	15.0 mg/L	N/A	N/A	0.5 mg/L	1.0 mg/L	not listed

* From the Official Compilation of Code Rules and Regulations of the State of New York, Title 6 Environmental Conservation, Chapter X, Division of Water Resources, Part 703.5; Class GA

[1] Common plasticizer, possibly from plastics or plastic solvents in the NDA

[2] Probably present in well organic phase, included with aqueous sample.

[3] Common laboratory contaminant.

[4] Range in upgradient well 80-02 for 1988 = 1.0 to 3.0 mg/l.

[5] Hexavalent

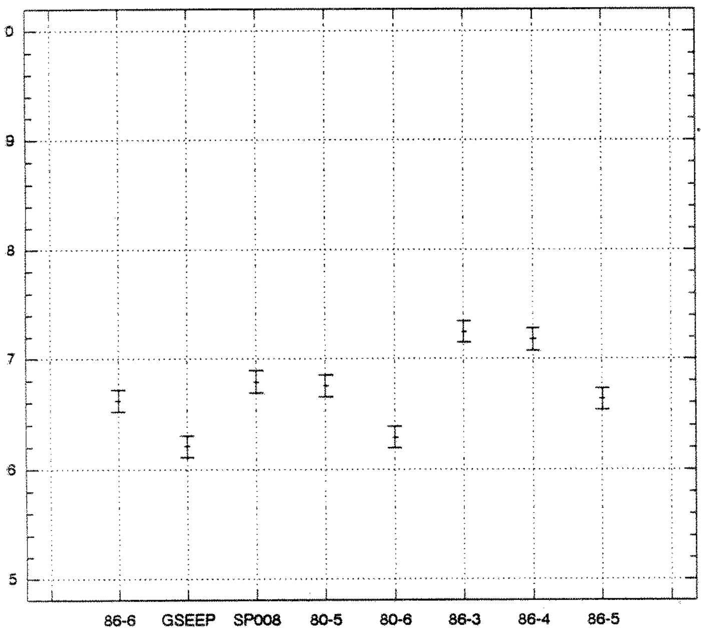


Figure E-1.

pH in groundwater samples from the Low-Level Radioactive Waste Lagoon Monitoring Unit. Well 86-6 is upgradient.

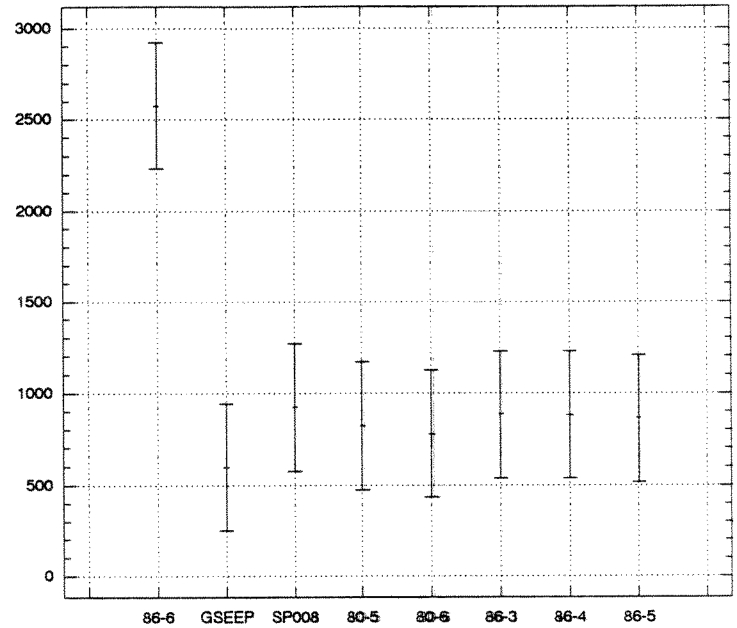


Figure E-2.

Conductivity (μmhos/cm at 25°C) in groundwater samples from the Low-Level Radioactive Waste Lagoon Monitoring Unit. Well 86-6 is upgradient.

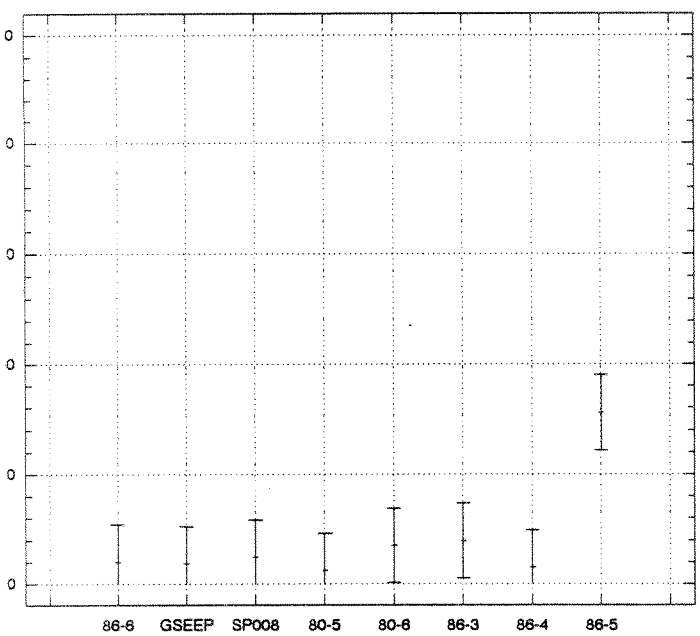


Figure E-3.

Total Organic Carbon (mg/L) in groundwater samples from the Low-Level Radioactive Waste Lagoon Monitoring Unit. Well 86-6 is upgradient.

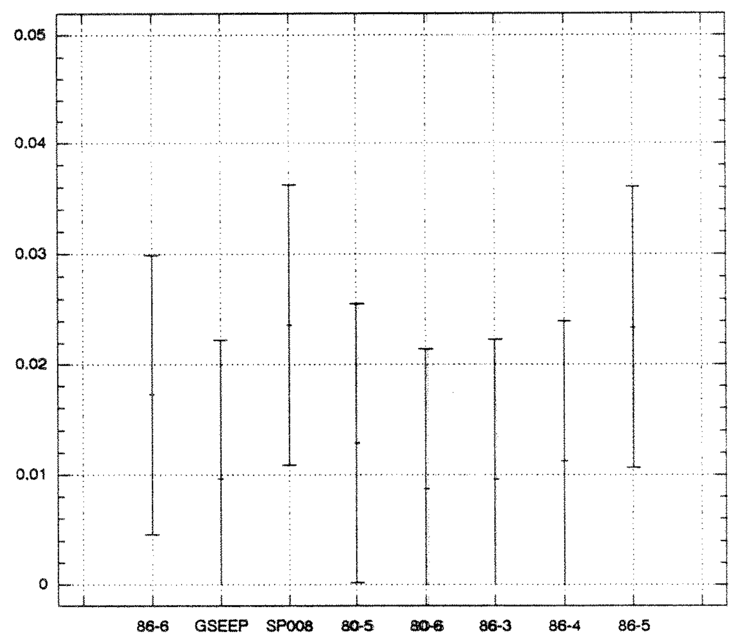


Figure E-4.

Total Organic Halogens (mg/L) in groundwater samples from the Low-Level Radioactive Waste Lagoon Monitoring Unit. Well 86-6 is upgradient.

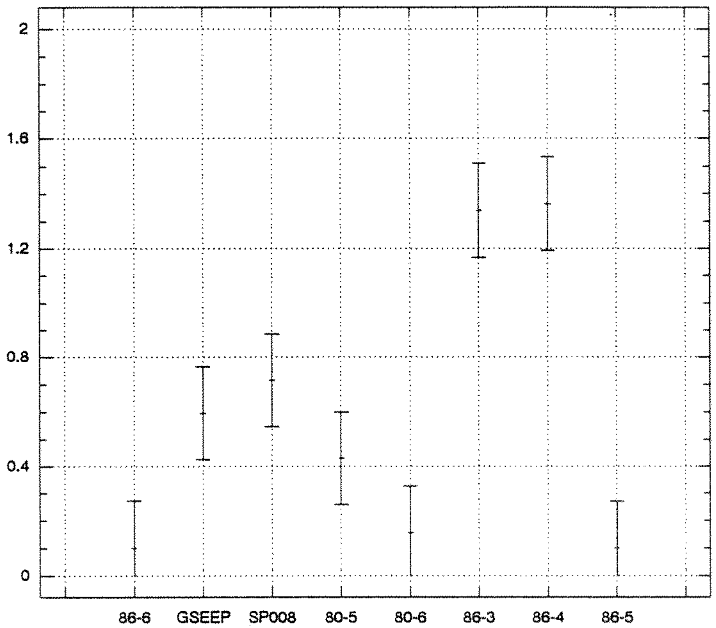


Figure E-5.

Nitrate-N (mg/L) in groundwater samples from the Low-Level Radioactive Waste Lagoon Monitoring Unit. Well 86-6 is upgradient.

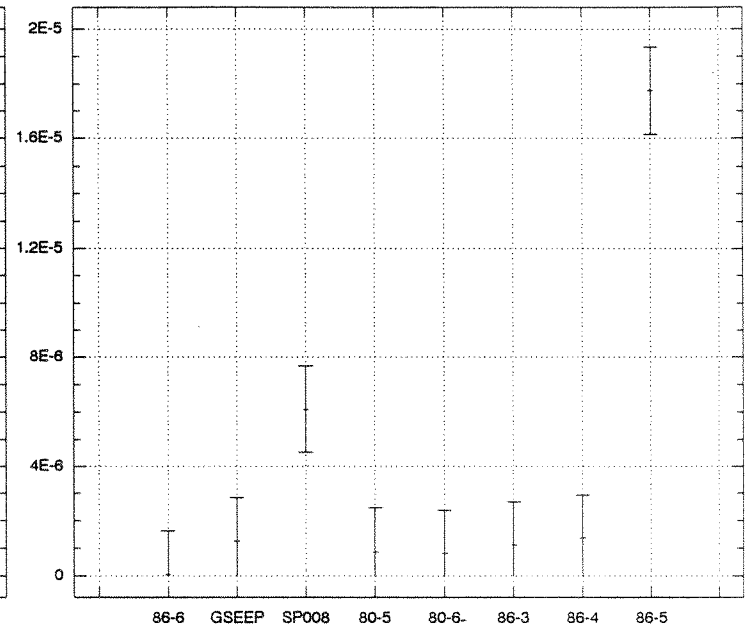


Figure E-6

Tritium activity (μCi/ml) in groundwater samples from the Low-Level Radioactive Waste Lagoon Monitoring Unit. Well 86-6 is upgradient. Figure E-7 follows without Well 86-5 to provide adequate scaling.

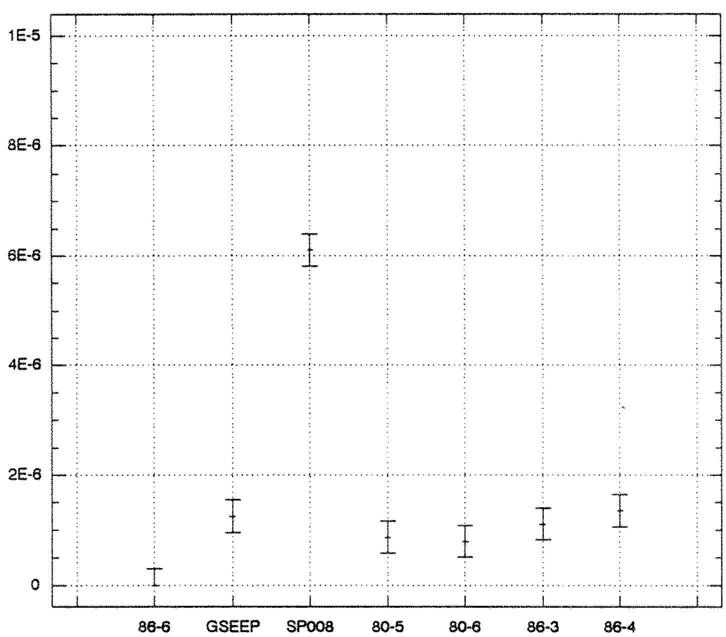


Figure E-7

Tritium activity (μCi/ml) in groundwater samples from the Low-Level Radioactive Waste Lagoon Monitoring Unit without Well 86-5.

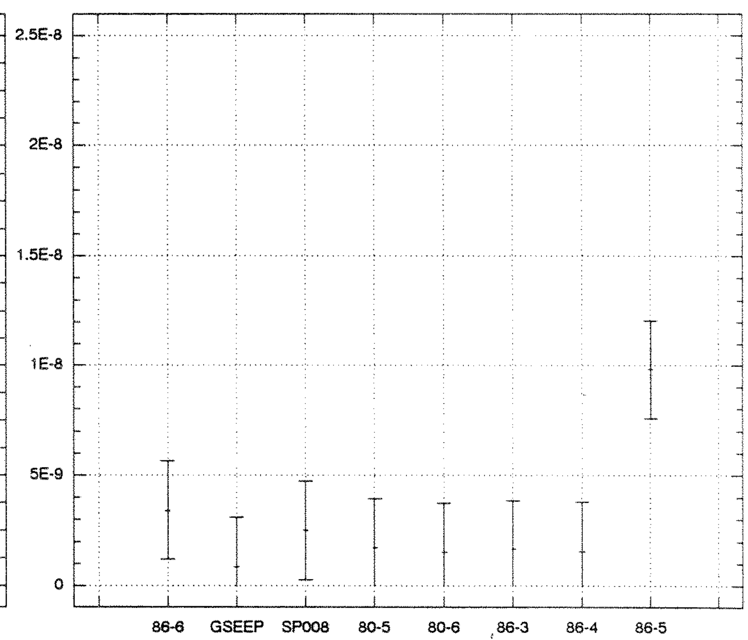


Figure E-8

Gross alpha activity (μCi/ml) in groundwater samples from the Low-Level Radioactive Waste Lagoon Monitoring Unit. Well 86-6 is upgradient.

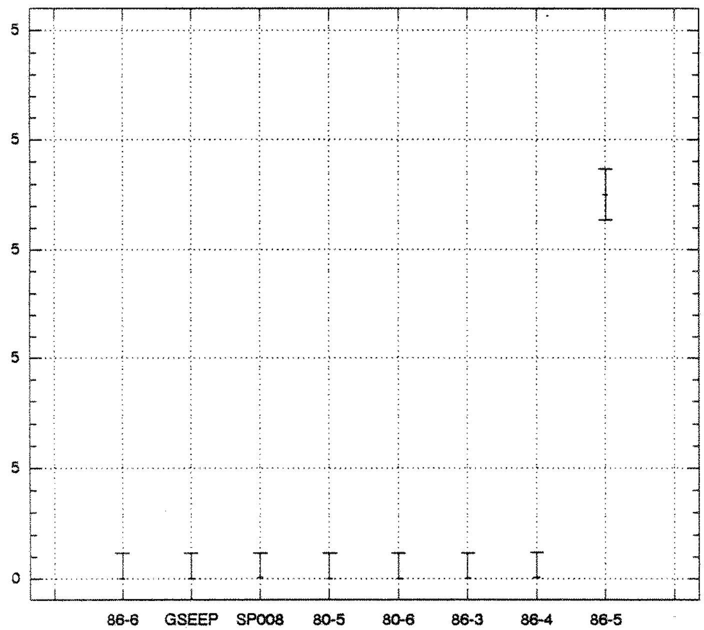


Figure E-9

Gross beta activity (μCi/ml) in groundwater samples from the Low-Level Radioactive Waste Lagoon Monitoring Unit. Well 86-6 is upgradient. Figure E-10 follows without Well 86-5 to provide adequate scaling.

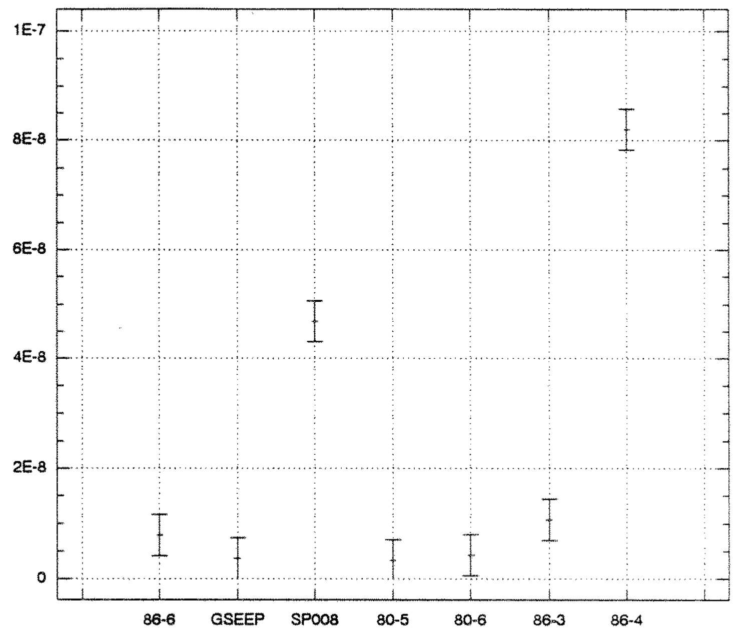


Figure E-10.

Gross beta activity (μCi/ml) in groundwater samples from the Low-Level Radioactive Waste Lagoon Monitoring Unit without Well 86-5 to provide adequate scaling.

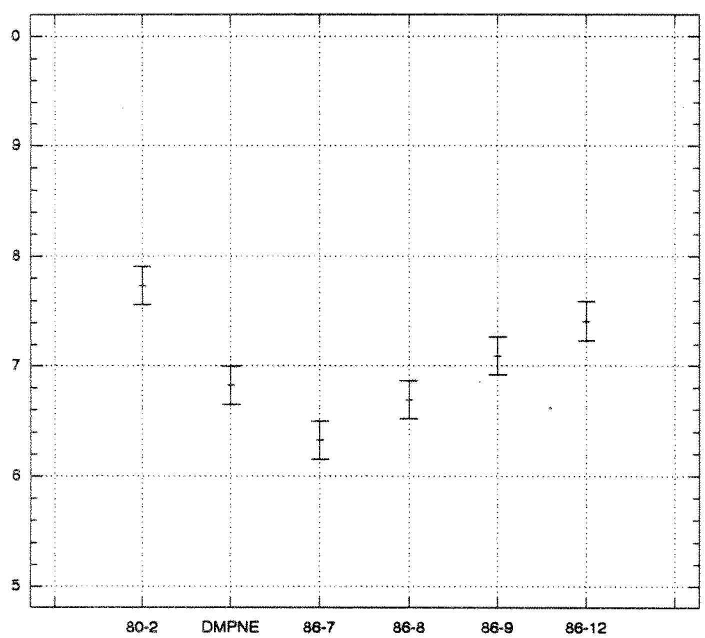


Figure E-11.

pH in groundwater samples from the High-Level Radioactive Waste Tank Complex Monitoring Unit. Well 80-2 is upgradient.

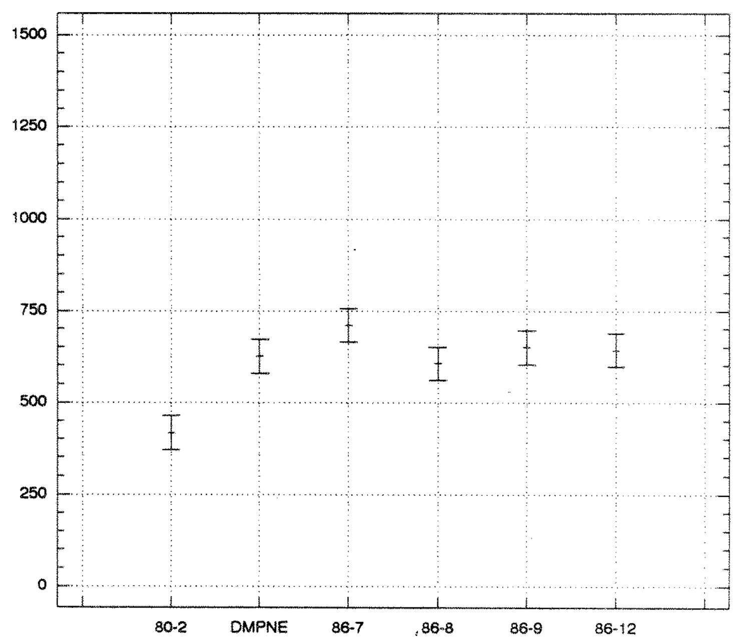


Figure E-12.

Conductivity (μmhos/cm at 25^{0}C) in groundwater samples from the High-Level Radioactive Waste Tank Complex Monitoring Unit. Well 80-2 is upgradient.

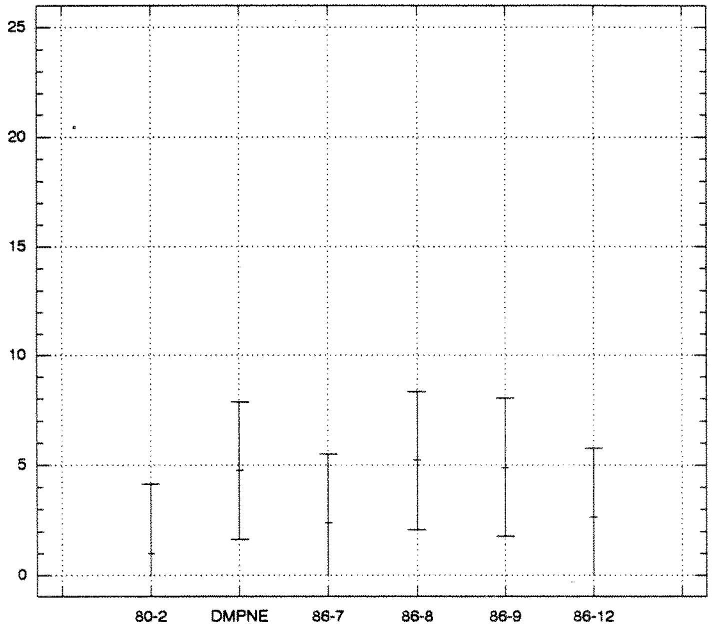


Figure E-13.

Total Organic Carbon (mg/L) in groundwater samples from the High-Level Radioactive Waste Tank Complex Monitoring Unit. Well 80-2 is upgradient.

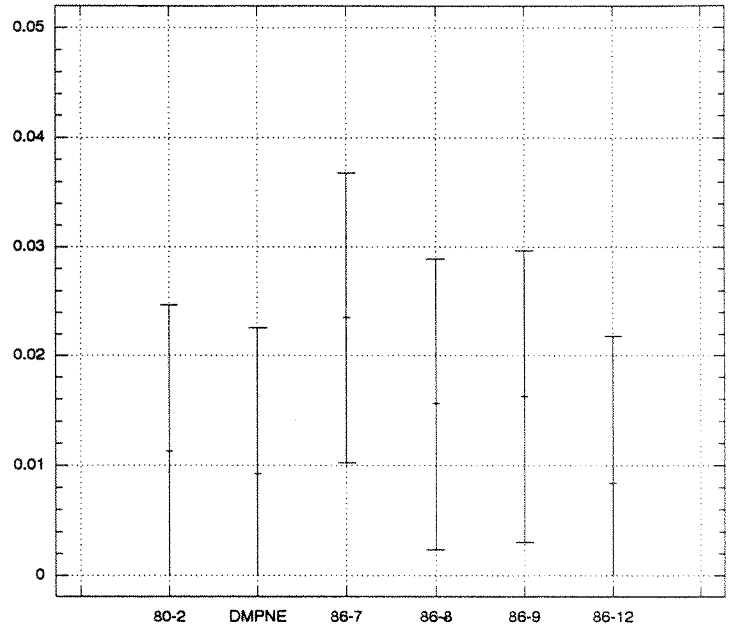


Figure E - 14.

Total Organic Halogens (mg/L)in groundwater samples from the High-Level Radioactive Waste Tank Complex Monitoring Unit. Well 80-2 is upgradient.

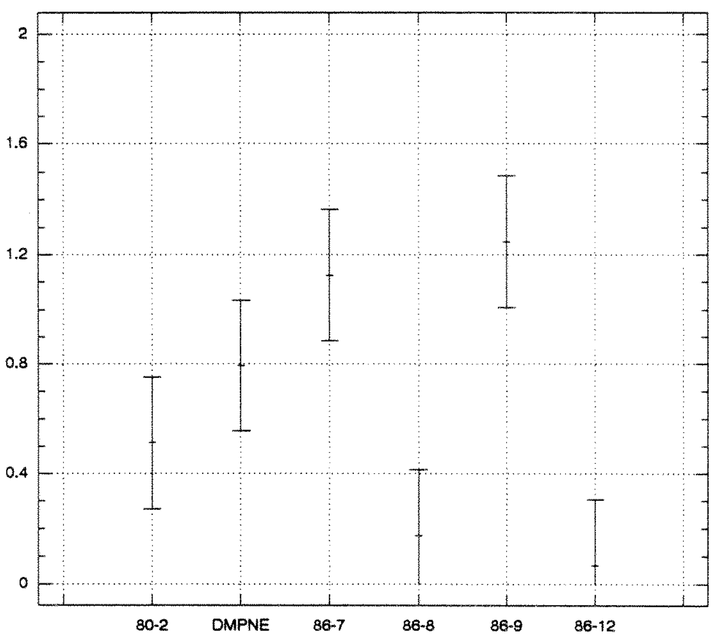


Figure E - 15.

Nitrate-N (mg/L) in groundwater samples from the High-Level Radioactive Waste Tank Complex Monitoring Unit. Well 80-2 is upgradient.

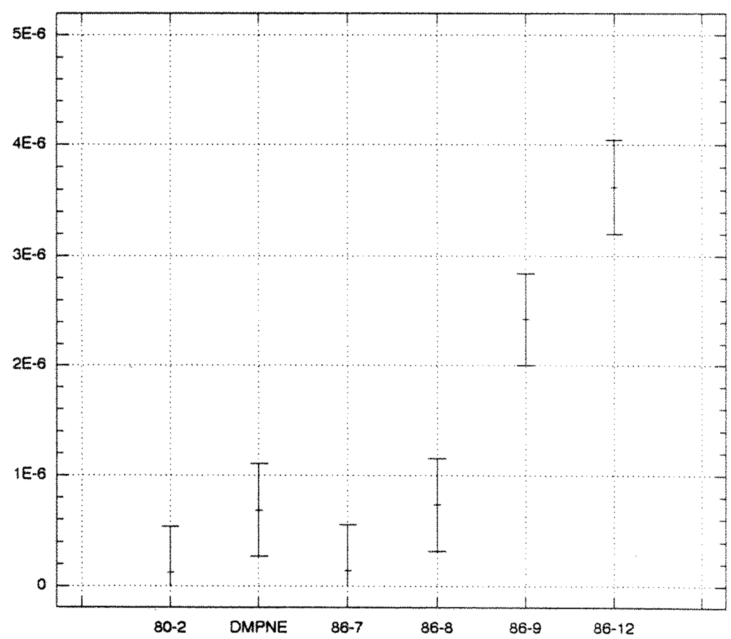


Figure E-16.

Tritium activity (μCi/ml) in groundwater samples from the High-Level Radioactive Waste Tank Complex Monitoring Unit. Well 80-2 is upgradient.

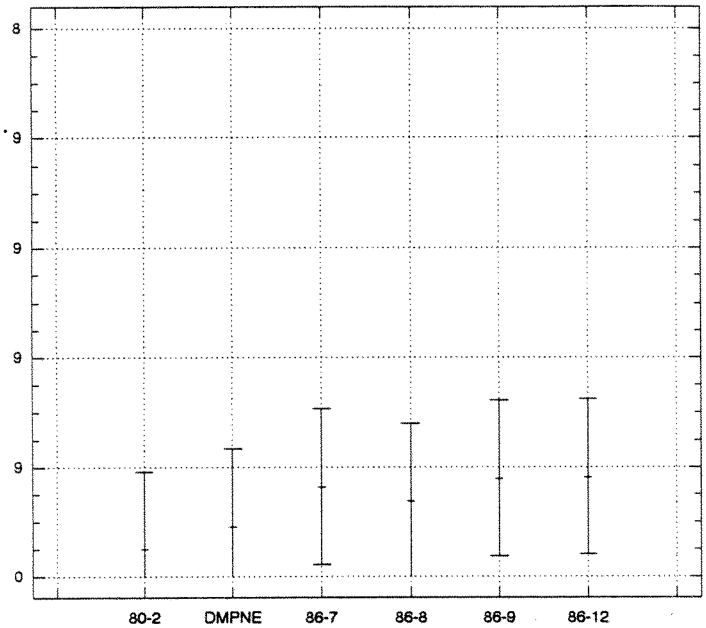


Figure E-17.

Gross alpha activity (μCi/ml) in groundwater samples from the High-Level Radioactive Waste Tank Complex Monitoring Unit. Well 80-2 is upgradient.

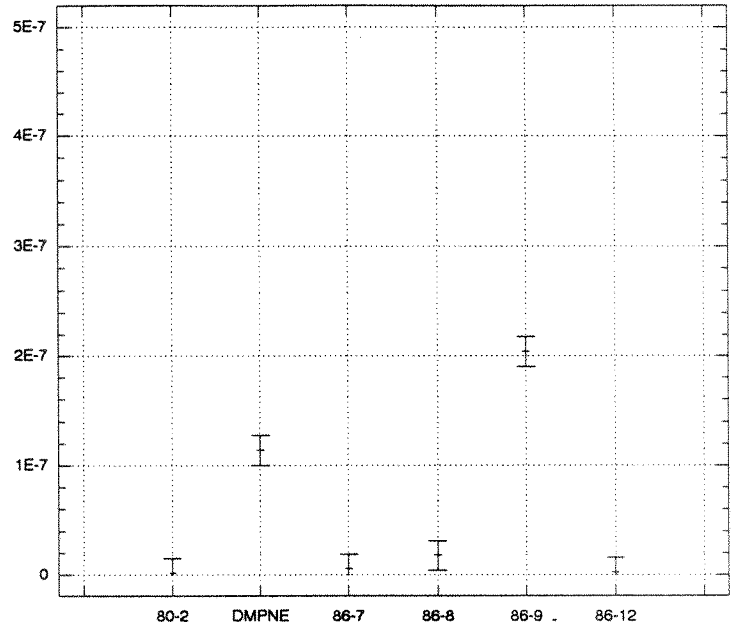


Figure E-18.

Gross beta activity (μCi/ml) in groundwater samples from the High-Level Radioactive Waste Tank Complex Monitoring Unit. Well 80-2 is upgradient.

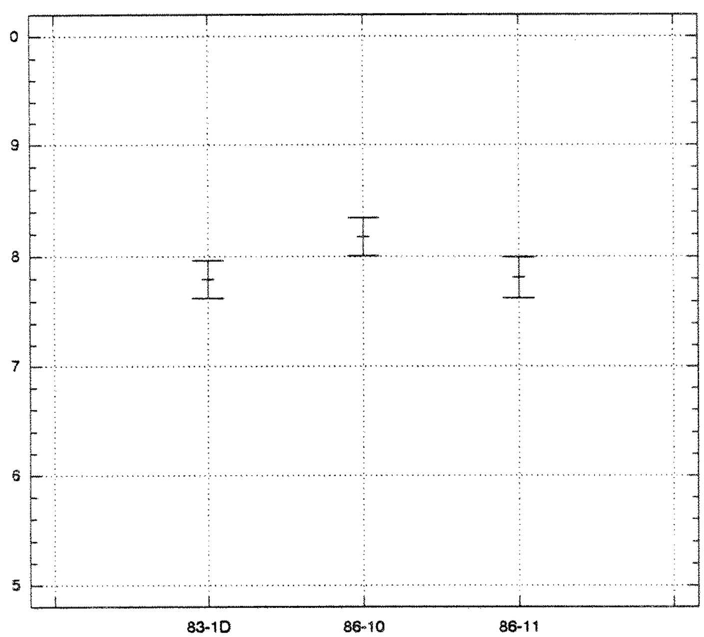


Figure E-19.

pH in groundwater samples from the NRC-Licensed Disposal Area Monitoring Unit. Well 83-1D is upgradient.

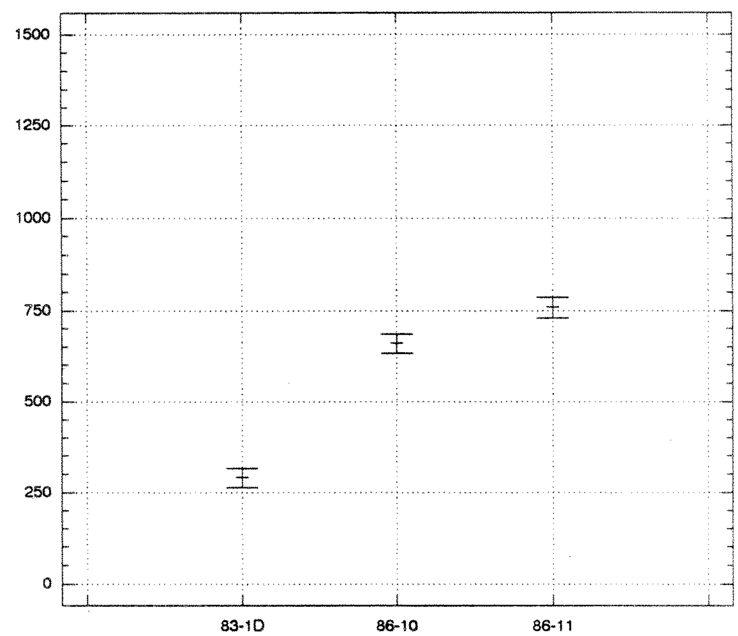


Figure E-20.

Conductivity (μmhos/cm at 25^0C) in groundwater samples from the NRC-Licensed Disposal Area Monitoring Unit. Well 83-1D is upgradient.

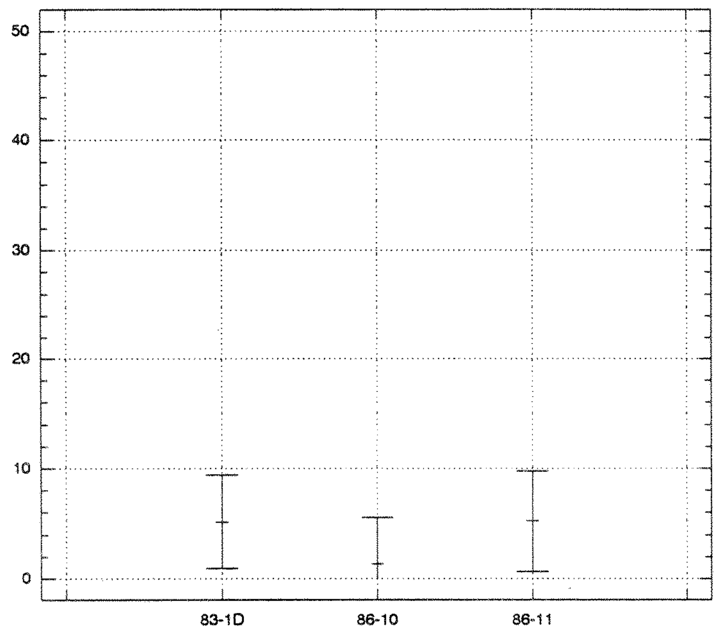


Figure E-21.

Total Organic Carbon (mg/L) in groundwater samples from the NRC-Licensed Disposal Area Monitoring Unit. Well 83-1D is upgradient.

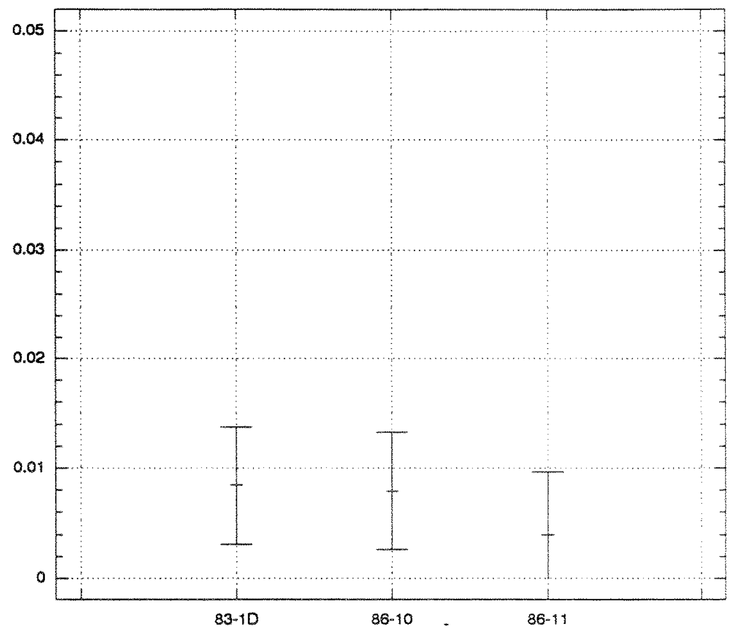


Figure E-22.

Total Organic Halogens (mg/L) in groundwater samples from the NRC-Licensed Disposal Area Monitoring Unit. Well 83-1D is upgradient.

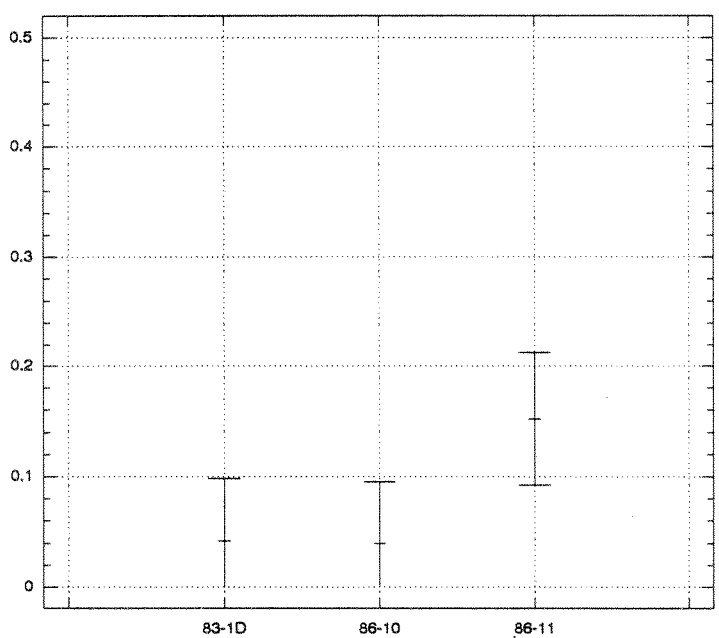


Figure E-23.

Nitrate-N (mg/L) in groundwater samples from the NRC-Licensed Disposal Area Monitoring Unit. Well 83-1D is upgradient.

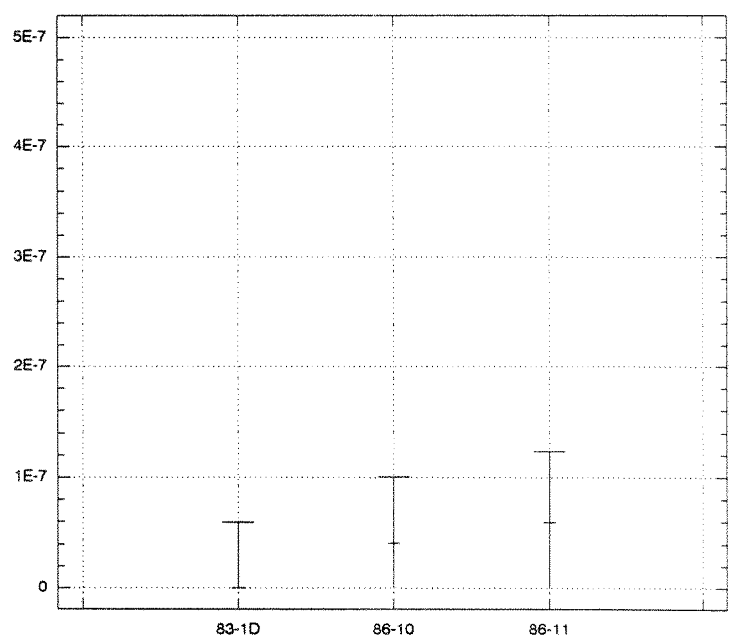


Figure E-24.

Tritium activity (μCi/ml) in groundwater samples from the NRC-Licensed Disposal Area Monitoring Unit. Well 83-1D is upgradient.

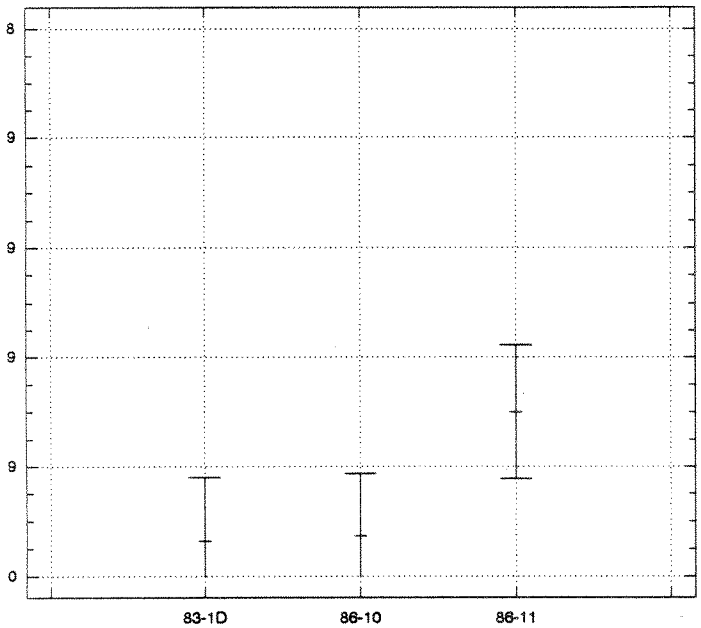


Figure E-25.

Gross alpha activity (μCi/ml) in groundwater samples from the NRC-Licensed Disposal Area Monitoring Unit. Well 83-1D is upgradient.

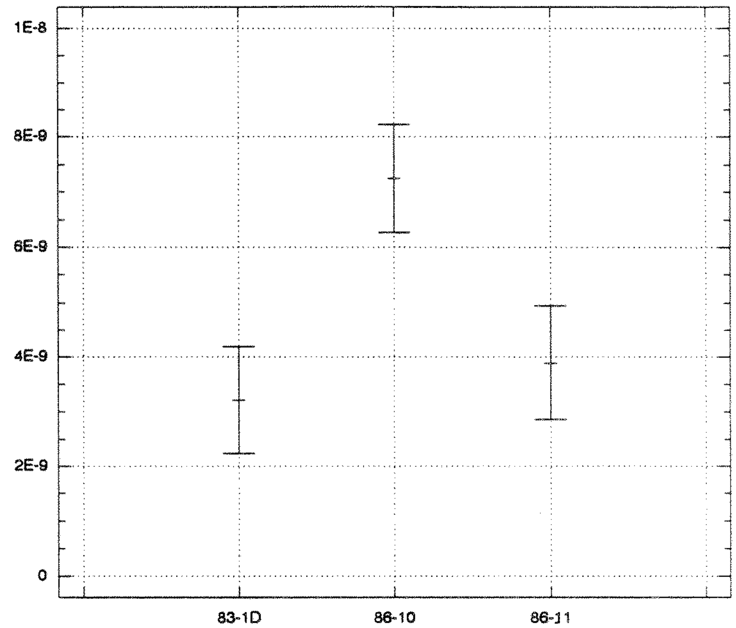


Figure E-26.

Gross beta activity (μCi/ml) in groundwater samples from the NRC-Licensed Disposal Area Monitoring Unit. Well 83-1D is upgradient.

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ALLUVIUM. Sedimentary material deposited by flowing water such as a river.

ALLUVIAL FAN. A cone-shaped deposit of alluvium made by a stream where it runs out onto a level plain.

AQUIFER. A water-bearing unit of permeable rock or soil that will yield water in usable quantities to wells. *Confined aquifers* are bounded above and below by less permeable layers. Groundwater in a confined aquifer is under a pressure greater than the atmospheric pressure. *Unconfined aquifers* are bounded below by less permeable material, but are not bounded above. The pressure on the groundwater in an unconfined aquifer at the top of the aquifer is equal to that of the atmosphere.

AQUITARD. A relatively impervious and semiconfining geologic formation that transmits water at a very slow rate compared to an aquifer.

BACKGROUND RADIATION. Includes both natural and manmade radiation such as cosmic radiation and radiation from naturally radioactive elements and from commercial sources and medical procedures.

BECQUEREL (BQ). A unit of radioactivity equal to one nuclear transformation per second.

CLASS A, B, AND C LOW-LEVEL WASTE. Waste classifications from the Nuclear Regulatory Commission's 10 CFR Part 61 rule. Maximum concentration limits are set for specific isotopes. Class A waste disposal is minimally restricted with respect to the form of the waste. Class B waste must meet more rigorous requirements to ensure physical stability after disposal. Greater concentration limits are set for the same isotopes in Class C Waste and it also must meet physical stability requirements. Moreover, special measures must be taken at the disposal facility to protect against inadvertent intrusion.

CONFIDENCE COEFFICIENT OR FACTOR. The chance or probability, usually expressed as a percentage, that a confidence interval includes some defined parameter of a population. The confidence coefficients usually associated with confidence intervals are 90%, 95%, and 99%.

COSMIC RADIATION. High-energy subatomic particles from outer space that bombard the earth's atmosphere. Cosmic radiation is part of natural background radiation.

COUNTING ERROR. The variability caused by the inherent random nature of radioactive disintegration and the detection process.

CURIE(CI). A unit of radioactivity equal to 37 billion (3.7×10^{10})nuclear transformations per second.

DETECTION LEVEL. The minimum concentration of a substance that can be measured with a 99% confidence that the analytical concentration is greater than zero.

DERIVED CONCENTRATION GUIDE (DCG). Concentrations of radionuclides in air and water in which a person continuously exposed and inhaling 8400 m^3 of air or ingesting 730 liters of water per year would receive an annual effective dose equivalent of 100 mrem per year from either mode of exposure. The committed dose equivalent is included in the DCGs for radionuclides with long half-lives. (See Appendix B)

DISPERSION. The process whereby solutes are spread or mixed as they are transported by groundwater as it moves through sediments.

DOSIMETER. A portable device for measuring the total accumulated exposure to ionizing radiation.

DOWNGRADIENT. The direction of water flow from a reference point to a selected point of interest. (See GRADIENT)

EFFECTIVE DOSE. See "Effective Dose Equivalent" under "Radiation dose."

EFFLUENT. Flowing out or forth; an outflow of waste. In this report, effluent refers to the liquid or gaseous waste streams released into the environment from the facility.

EFFLUENT MONITORING. Sampling or measuring specific liquid or gaseous effluent streams for the presence of pollutants.

EXPOSURE. Subjecting a target (usually living tissue) to radiation.

FALLOUT. Radioactive materials mixed into the earth's atmosphere. Fallout constantly precipitates onto the earth.

GRADIENT. Change in value of one variable with respect to another variable, especially vertical or horizontal distance, e.g., gravity, temperature, magnetic intensity, electric potential.

GROUNDWATER. Subsurface water in the pore spaces of soil and geologic units.

HALF-LIFE. The time in which half the atoms of a radionuclide disintegrate into another nuclear form. The half-life may vary from a fraction of a second to thousands of years.

HIGH-LEVEL WASTE (HLW). The highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid, that contains a combination of transuranic waste and fission products in concentrations sufficient to require permanent isolation.

HYDRAULIC CONDUCTIVITY. The ratio of flow velocity to driving force for viscous flow under saturated conditions of a specified liquid in a porous medium; the ratio describing the rate at which water can move through a permeable medium.

ION. An atom or group of atoms with an electric charge.

ION EXCHANGE. The reversible exchange of ions contained in a crystal for different ions in solution without destroying the crystal structure or disturbing the electrical neutrality.

ISOTOPE. Different forms of the same chemical element that are distinguished by having different numbers of neutrons in the nucleus. An element can have many isotopes. For example, the three isotopes of hydrogen are protium, deuterium, and tritium.

KAME DELTA. A conical hill or short irregular ridge of gravel or sand deposited in contact with glacier ice.

LACUSTRINE SEDIMENTS. A sedimentary deposit consisting of material pertaining to, produced by, or formed in a lake or lakes.

LEACHED HULLS. Stainless steel cladding that remains after acid dissolution of spent fuel.

LOW-LEVEL WASTE. Radioactive waste not classified as high-level waste, transuranic waste, spent fuel, or uranium mill tailings. (See Class A,B,C low-level waste).

MAXIMALLY EXPOSED INDIVIDUAL. A hypothetical person who remains in an uncontrolled area who would, when all potential routes of exposure from a facility's operations are considered, receive the greatest possible dose equivalent.

MEAN. The average value of a series of measurements.

MILLIREM (MREM). A unit of radiation dose equivalent that is equal to one one-thousandth of a rem. An individual member of the public can receive up to 500 millirems per year according to DOE standards. This limit does not include radiation received for medical treatment or the 100 to 360 mrem that people receive annually from background radiation.

MINIMUM DETECTABLE CONCENTRATION. The smallest amount or concentration of a radioactive or nonradioactive element that can be reliably detected in a sample.

MIXED WASTE. A waste that is both radioactive and hazardous.

OUTFALL. The end of a drain or pipe that carries waste water or other effluents into a ditch, pond, or river.

PARTICULATES. Solid particles and liquid droplets small enough to become airborne.

PERSON-REM. The sum of the individual radiation dose equivalents received by members of a certain group or population. It may be calculated by multiplying the average dose per person by the number of persons exposed. For example, a thousand people each exposed to one millirem would have a collective dose of one person-rem.

PLUME. The distribution of a pollutant in air or water after being released from a source.

PROGLACIAL LAKE. A lake occupying a basin in front of a glacier; generally in direct contact with the ice.

RAD. Radiation absorbed dose. One hundred ergs of energy absorbed per gram.

RADIATION. The process of emitting energy in the form of rays or particles that are thrown off by disintegrating atoms. The rays or particles emitted may consist of alpha, beta, or gamma radiation.

- ALPHA RADIATION. The least penetrating type of radiation. Alpha radiation can be stopped by a sheet of paper or outer dead layer of skin.

- BETA RADIATION. Electron emitted from a nucleus during fission and nuclear decay. Beta radiation can be stopped by an inch of wood or a thin sheet of aluminum.

- GAMMA RADIATION. A form of electromagnetic, high-energy radiation emitted from a nucleus. Gamma rays are essentially the same as x-rays and require heavy shielding such as lead, concrete, or steel to be stopped.

- INTERNAL RADIATION. Radiation originating from a source within the body as a result of the inhalation, ingestion, or implantation of natural or manmade radionuclides in body tissues.

RADIATION DOSE.

- ABSORBED DOSE. The amount of energy deposited by radiation in a given amount of material. Absorbed dose is measured in rads.

- COLLECTIVE DOSE EQUIVALENT. The sum of the dose equivalents for individuals comprising a defined population. The per capita dose equivalent is the quotient of the collective dose equivalent divided by the population size. (See PERSON-REM).

- COMMITTED DOSE EQUIVALENT (dose commitment). The total dose equivalent accumulated in an organ or tissue in the fifty years following a single intake of radioactive materials into the body.

- CUMULATIVE DOSE EQUIVALENT. The total dose one could receive in a period of fifty years following release of radionuclides to the environment, including the dose that could occur as a result of residual radionuclides remaining in the environment beyond the year of release.

- DOSE EQUIVALENT. The product of the absorbed dose, the quality factor, and any other modifying factors. The dose equivalent is a quantity for comparing the biological effectiveness of different kinds of radiation on a common scale. The unit of dose equivalent is the rem.

- EFFECTIVE DOSE EQUIVALENT. An estimate of the total risk of potential health effects from radiation exposure. It is the sum of the committed effective dose equivalent from internal deposition and the effective dose equivalent from external penetrating radiation received during a calendar year. The committed effective dose equivalent is the sum of the individual organ committed dose equivalents (fifty years) multiplied by weighting factors that represent the proportion of the total random risk that each organ would receive from uniform irradiation of the whole body.

RADIOACTIVITY. A property possessed by some elements such as uranium whereby alpha, beta, or gamma rays are spontaneously emitted.

RADIOISOTOPE. A radioactive isotope of a specified element. Carbon-14 is a radioisotope of carbon. Tritium is a radioisotope of hydrogen.

RADIONUCLIDE. A radioactive nuclide. Radionuclides are variations (isotopes) of elements. They have the same number of protons and electrons but different numbers of neutrons, resulting in different atomic masses.There are several hundred known nuclides, both man-made and naturally occurring.

REM. An acronym for Roentgen Equivalent Man. A unit of radiation exposure that indicates the potential effect on human cells.

SIEVERT. A unit of dose equivalent from the International System of Units equal to one joule per kilogram.

SPENT FUEL. Nuclear fuel that has been exposed in a nuclear reactor; this fuel contains uranium, activation products, fission products, and plutonium.

STANDARD DEVIATION. An indication of the dispersion of a set of results around their average.

THERMOLUMINESCENT DOSIMETER (TLD). A material that luminesces upon heating after being exposed to radiation. The amount of light emitted is proportional to the amount of radiation to which it has been exposed.

UPGRADIENT. Referring to the flow of water or air, it is analogous to upstream. A point that is "before" an area of study that is used as a baseline for comparison with downstream data. See GRADIENT and DOWNGRADIENT.

WATERSHED. The area contained within a drainage divide above a specified point on a stream.

WATER TABLE. The upper surface in a body of groundwater. The surface in an unconfined aquifer or confining bed at which the pore water pressure is equal to atmospheric pressure.

WHOLE-BODY DOSE. A radiation dose that involves exposure of the entire body.

Abbreviations for Units of Measure

Radioactivity

Symbol	*Name*
Ci	curie
mCi	millicurie (1E-03 Ci)
μCi	microcurie (1E-06 Ci)
nCi	nanocurie (1E-09 Ci)
pCi	picocurie (1E-12 Ci)
fCi	femtocurie (1E-15Ci)
aCi	attocurie (1E-18 Ci)
Bq	becquerel (27 pCi)

Volume

Symbol	*Name*
cm^3	cubic centimeter
L	liter
mL	milliliter
m^3	cubic meter
ppm	parts per million
ppb	parts per billion

Dose

Symbol	*Name*
Sv	sievert (100 rems)
Gy	gray (100 rads)

Time

Symbol	*Name*
y	year
d	day
h	hour
m	minute
s	second

Length

Symbol	*Name*
m	meter
km	kilometer (1E+03 m)
cm	centimeter (1E-02 m)
mm	millimeter (1E-03 m)
μm	micrometer (1E-06 m)

Area

Symbol	*Name*
ha	hectare (10,000 m^2)

Mass

Symbol	*Name*
g	gram
kg	kilogram (1E+03 g)
mg	milligram (1E-03)
μg	microgram(1E-06 g)
ng	nanogram (1E-09 g)
t	metric ton (10^3 kg)

Conversion Table

Multiply	*by*	*To obtain*	*Multiply*	*by*	*To obtain*
in.	2.54	cm	cm	0.394	in.
ft	0.305	m	m	3.28	ft.
mi	1.61	km	km	0.621	mi
lb	0.454	kg	kg	2.205	lb
liq. qt.	0.946	L	L	1.057	liq. qt.
ft^2	0.093	m^2	m^2	10.76	ft^2
ha	2.47	acres	acres	0.405	ha
mi^2	2.59	km^2	km^2	0.386	mi^2
ft^3	0.028	m^3	m^3	35.7	ft^3
dpm	0.450	pCi	pCi	2.22	dpm
nCi	1000	pCi	pCi	0.001	nCi
pCi/L	1E-09	μCi/mL	μCi/mL	1E+09	pCi/L
pCi/m^3	1E-12	Ci/m^3	Ci/m^3	1E+12	pCi/m^3
becquerel	2.7E-11	curie	curie	3.7E+10	becquerel
gray	100	rad	rad	0.01	gray
sievert	100	rem	rem	0.01	sievert
ppb	0.001	ppm	ppm	1000	ppb
ppm	1.0	mg/L	mg/L	1.0	ppm

Unit Prefixes

Factor	*Prefix*	*Symbol*
1E+09	giga	G
1E+06	mega	M
1E+03	kilo	k
1E-02	centi	c
1E-03	milli	m
1E-06	micro	μ
1E-09	nano	n
1E-12	pico	p

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Buffalo News, Buffalo, New York *

Salamanca Republican Press,
Salamanca, New York *

Springville Journal, Springville, New York *

* News release summary